

Freshwater Turtles and Tortoises of India

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Wildlife Institute of India



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Wildlife and Protected Areas

Freshwater Turtles and Tortoises of India

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Envis Bulletin
Wildlife and Protected Areas

Freshwater Turtles and Tortoises of India

Editor
Karthikeyan Vasudevan

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Jatinder Chadha

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Mail Bag

ENVIS Bulletin Vol. 11, No. 1, 2008: Special Habitats and Threatened Plants of India

It was indeed a pleasure to receive a copy of Vol. 11 No. 1 2008 of ENVIS on "Special habitats and Threatened plants of India." I have gone through it and enjoyed the well written and illustrated articles which have enhanced my understanding of the subject tremendously. Particularly, I have really gained from the observations in Section 1: Trans- Himalaya, a region (cold deserts) of Himachal Pradesh which I have visited during the couple of years recently. This extremely informative publication is a rich source of reference for a researcher like me who is working on floristics of Punjab, Chandigarh and Western Himalaya since the last 45 years. What is really commendable is that not only the professionals but the amateurs will also be greatly encouraged and inspired from it. My hearty congratulations to WII's dedicated team, Dr. V.B. Mathur, Dr. G. S. Rawat and Dr. Jatinder Chadha for bringing out this superb issue with an excellent get up and design. I look forward to receive copies of further publications of ENVIS

Prof. M. Sharma

Former Dean

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Many thanks for sending across the special issue of ENVIS bulletin on Special Habitats and Threatened Plants of India. I take this opportunity to congratulate the entire team for bringing out the publication with focus on special habitats and being able to cover almost all regions in India. The photographs really add to the knowledge of the endemic, rare and endangered species. The publication is like its title "special and threatened". I wish and hope that WII brings out many more publications on various themes and continue enriching knowledge of amateurs like me. Best wishes.

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I have received ENVIS Bulletin "Special Habitats and Threatened Plants of India". It is beautiful and a useful volume as it contains some excellent articles. Prof. Rawat, Jatinder and all of you have to be congratulated. With Best Wishes.

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Nice review of the threatened plants and special habitats of India. I appreciate beautiful colored photographs also. However, I found that information about the threatened plants of Punjab is missing from the volume. These may also be incorporated in the next edition. Thanks a lot for sending the copy.

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This is an exceptional reference for those in the search for threatened plants of India and their conservation. The color pictures of plants and habitats are well illustrated. My warmest congratulations to Project Coordinator, Dr. V. B. Mathur, Dr. Jatinder Chadha and Dr. G.S. Rawat. Best Wishes for your future publications.

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Though I am too late for acknowledgement of this book due to my inordinate delay, I am extremely grateful to you for sending complementary copy of this volume. This book contains many interesting articles, which will be immensely helpful for my teaching in Post Graduate students, since I teach Diversity of Indian Flora with special reference to endemic and exotic taxa of India and Phytogeographical regions of India and their characteristic flora. This book contains many coloured illustrations, which are not available in literature of Post Graduate Students. Such type of book is very rare in Indian market. 'Hope you will publish more volumes containing many of interesting articles dealing with plants. Wishing you all the best,

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I am very pleased to receive 'Special Habitats and Threatened Plants of India'. It is extremely informative and nicely done. Congratulations to Dr. Rawat, Dr. Mathur and Jatinder on producing an excellent publication.

Vivekanand Sharma
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I just read the ENVIS publication titled 'Special habitats and Threatened plants of India'. I must congratulate you on the publication. It is a very well done bulletin with excellent information in the form of short papers. The language though scientific is easily understandable to the common man and the pictures are very helpful in understanding the plant and habitats better. It is surely one publication which will be of great help to researchers and scientist, students and common man as well as the government officials and people in a position to take environmentally sound decisions. Wish you the best in your future publications as well.

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I have received the special ENVIS bulletin, which you have sent, which is very well edited and elegantly produced. Please accept my sincere appreciation for sending me a copy, which has very interesting information. Thanking you.

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Thank you all for your valuable comments and suggestions which will help us to improve the quality of our ENVIS publications. We will incorporate these as appropriate in the online edition of this issue.

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Wildlife Institute of India

DIRECTOR'S NOTE

Turtles and Tortoises are group of oldest living reptiles that evolved 200 million years ago. They occur worldwide and are represented by 460 species out of which ten have gone extinct in the recent past. As per the 2009 IUCN Red List, 131 turtle species out of 212 species assessed are officially listed as globally threatened (Critically Endangered, Endangered or Vulnerable). Based on the slightly different taxonomy in this checklist, 134 species i.e. 40.2% of all 333, turtle species are considered threatened, with another nine provisionally assessed as threatened. Thus 43.2% of all turtles are threatened. There are around 89 species of Asian tortoises and freshwater turtles of which many are threatened.

This publication brings together expertise and current knowledge on this group of animals in a manner which could be used by managers, policy makers as well as scientific community. It is hoped that this publication would provide knowledge base to launch species conservation initiatives.

We dedicate this issue to the '2010 International Year of Biodiversity (IYB)' being observed throughout the globe.

(P.R. Sinha)
Director

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Dr. Ramakrishna
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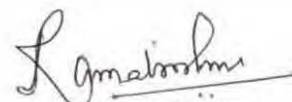
FOREWORD

Reptiles were the dominant group of vertebrates during the Mesozoic period; most of the orders of reptiles were established by the end of Triassic and some became extinct at that time. Of the 19 orders of Reptiles only 4 survive today viz., Crocodelia, Testudines, Squamata and Rhynchocephalia. Testudines or Chelonians are most primitive, amphibious, some becoming secondarily terrestrial, poikilothermous animals well protected by a bony or leathery shell. The modern chelonians have maintained numerous characters of their ancestors which flourished in the Permian epoch. These ancient groups of reptiles have no close relationship to the other order of recent or extinct group of reptiles and as such there is deep mystery regarding their origin and relationship. In addition, they have undergone least changes from Triassic to this date. Several such species, in recent years are threatened by human activities caused by inadvertent actions or ignorance about their role in ecological balance.

Freshwater turtle species are being heavily exploited for food and in some cases for medicine and the harvest levels are unregulated and unsustainable even in the recent times. The very rapidly deteriorating status of tortoises and freshwater turtles in Southeast Asia due to over exploitation and habitat destruction has resulted in an increasing number of these species being listed as Extinct, Endangered, Vulnerable and Near Threatened category (IUCN). A few of the Indian Species are listed under Appendix of CITES and several species are listed under Schedules of the Indian Wildlife (Protection) Act, 1972.

The need for the conservation of biological resources and biodiversity assessment has increased during the last few years, it is indeed in this context the Wildlife Institute of India has felt the need of preparing a State-of-the-Art Report on the distribution of this ecologically important group of animals.

The present compilation entitled "*Freshwater Turtles and Tortoises of India*" will help to understand the taxonomy, ecology and distribution of the group and generate awareness on their conservation.


(Ramakrishna)

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EDITOR'S NOTE

This issue of ENVIS Bulletin on "Freshwater turtles and tortoises" is an attempt to bring together information on a group of reptiles that has received less attention from conservation community in India. We had initially sent a letter to 24 potential contributors on 9th of April 2009, introducing the WII's ENVIS Bulletin and the intention of bringing out an issue focussing on freshwater turtles and tortoises in India. We got responses from 18 primary contributors from different parts of the country expressing their eagerness to contribute to articles. Over numerous email exchanges and telephonic conversations with different contributors, spanning over 12 months; articles were received, reviewed, edited and this issue has been brought out.

In all, the volume contains 19 articles and two box summaries that have been arranged into four sections. The section dealing with 'Taxonomy' contains two articles that highlight the historical landmarks that lead to the discovery of several freshwater turtles and tortoises. The pioneering workers in the chelonian taxonomy and their contributions have been mentioned. The Zoological Survey of India Museum in Kolkata is a repository of collections dating back to 1853. This article makes an important contribution by listing all the accessions of freshwater turtles and tortoises in the Museum. This will be a useful reference to chelonian researchers in future.

The section on 'Ecology and Distribution' contains 12 articles addressing some aspects of the natural history and geographic range of all the 28 species of freshwater turtles and tortoises that occur in the country. Several scattered locality records and observations on their behaviour, diet and reproductive ecology have been brought together in these articles. These articles provide the much needed annotated baseline information on the ecology of species occurring within the country.

The section on 'Conservation' is dedicated to reports on various conservation initiatives taken up in the country. The Gangetic river system, including the Chambal has an enormous diversity of freshwater turtles. This region has also been the focus of conservation programmes targetting freshwater turtles. Many researchers and civil society organizations have taken part in this and their experiences are shared here. Husbandry practices and conservation breeding of turtles and tortoises are also dealt with in this section. The final section in this issue is 'Bibliography', which has 392 references on freshwater turtles and tortoises with an Author and a Taxon index.

The articles in this issue of ENVIS Bulletin bring a wide array of information on freshwater turtles and tortoises of India. This can promote dissemination of information on taxonomy, the threats they face and the measures that can be taken to conserve them.

(Kartikeyan Vasudevan)

Chapter 01

The Discovery of Indian Turtles, with Notes on Publications, Type Localities and Type Repositories

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Introduction

An appreciation of India's turtle diversity, reported as the richest in the world (Iverson, 1992), perhaps would include historical aspects behind its discovery. This essay traces the history of the discovery of Indian turtles, from Linnean to recent times. It retains the original orthography (as derived from an examination of the original publication) and I have attempted to trace all primary types of Indian turtles. Further biographical notes on important collectors and written contributors can be found in the works of Adler (1989), Archer (1962), Bauchot *et al.* (1990), Das (2004), Dawson (1946), Fransen *et al.* (1997) and Leviton and Aldrich (2000).

Appendix 1 comprises institutional repositories of turtle type material and Appendix II is an analysis of turtle names.

The Linnean period (1758–)

Carolus Linnaeus (1707–1778), in the 10th edition of 'Systema Naturae', described several turtles, of which three marine species are known from India. All were allocated to the genus *Testudo*, though none of the types were collected from India. The type locality of the first of these, *Testudo Caretta*, current name- *Caretta caretta* (Linnaeus, 1758) was indicated as "insulas Americanas" in the original description, and was restricted to "Bermuda Island" (32°20'N; 64°45'W, the Atlantic Ocean) by Smith and Taylor (1950), and further to "Bimini, British Bahamas" (25°44'N; 79°15'W) by Schmidt (1953). Wallin (1985) indicated that no type specimen of *Testudo caretta* existed. Another marine turtle described by Linnaeus was *Testudo Mydas*, current name- *Chelonia mydas* (Linnaeus, 1758). The NHRM 19, 26 and 231 syntypes, were from "Insulas pelagi: insulam Adscensionis" (= islands of the oceans: Ascension Island and so on.), restricted to "Insel Ascension" (= Ascension Island, 07°57'S; 14°22'W, in the Atlantic Ocean) by Mertens and Müller (1928). The third species is *Testudo imbricata*, current name- *Eretmochelys imbricata* (Linnaeus, 1766). Its presumed holotype is ZMUU 130, according to Smith and Smith (1979), although Wallin (1985) indicated that no type specimen ever existed. The original description mentioned that it originated from "Mari Americano, Asiatico" (= American and Asian seas), and was restricted to "Bermuda" (32°20'N; 64°45'W; in the Atlantic Ocean) by Smith and Taylor (1950).

Other sea turtle species were described subsequently. For instance, *Chelonia olivacea*, current name- *Lepidochelys olivacea* (Eschscholtz, 1829), based on types that are probably in MZT, according to Smith and Smith (1979), was from "chinesische Meer" (= China Sea), "Bai von Manilla" (= Manila Bay, 14°37'N; 120°58'E, Luzon, the Philippines) and "Sumatra" (in the Greater Sundas, Indonesia), and *Testudo coriacea*, current name- *Dermochelys coriacea* (Vandelli, 1761), whose holotype is an uncatalogued ZMUP specimen (Fretey and Bour, 1980). Vandelli (1761), in his letter to Linnaeus, gave the type locality as "maris Tyrrheni oram in agro Laurentiano" (= to the mouth of the Tyrrhenian Sea in Laurentium countryside), although Linnaeus (1766) gave the provenance as "Mari mediterraneo, Adriatico varius" (= either the Mediterranean Sea or the Adriatic), which was restricted to "Palermo, Sicily" (38°08'N; 13°23'E; in Italy) by Smith and Taylor (1950), and restricted again by Fretey and Bour (1980) to "la côte romaine (Italie), Mer Tyrrhénienne, Méditerranéenne occidentale" (= the Roman coast [Italy], Tyrrhenian Sea, western Mediterranean Sea), which Bour and Dubois (1983) restricted to "Laurentum, between Lido di Ostia and Tor Paterno, shore of the Tyrrhenian Sea, Italy" (not extant at present and once located at ca. 41°42'N; 12°17'E, about 7 km from Lido di Ostia and 4 km from Tor Paterno).

Colonial Period: Europe

Intense British interest in the natural history of her colonies spurred explorations in hitherto uncharted areas of the Empire. Prominent explorers included Major-General Thomas Hardwicke (1756–1835), an armyman,

who served in the Bengal Artillery of the East India Company, and collected natural history specimens and coloured sketches of plants and animals. Hardwicke's collection of natural history art ran into some 32 folio volumes that included over 2,000 drawings, of which 366 were of amphibians and reptiles. These were based on specimens collected/observed by his artists around places he was posted, especially Bengal and the United Provinces. His most famous contribution was a work which he collaborated with John Gray (1800–1875) of the British Museum, entitled 'Illustrations of Indian Zoology' (Gray, 1830–1835). The text was not published, owing to Hardwicke's premature death. The work was famous in depicting several turtle iconotypes, including *Emys baska*, current name- *Batagur baska* (Gray, 1830), which was apparently not based on biological material (= type specimens), and type locality was not specified, and was later restricted to "India" by Gray (1831); *Emys dhongoka*, current name- *Batagur dhongoka* (Gray, 1832), the type of which is currently untraced, and no type locality was specified, was subsequently restricted by Smith (1931:130) to "N. India"; and *Emys kachuga*, current name- *Batagur kachuga* (Gray, 1831) (Plate 1A), similarly without type material or specific type locality, again restricted by Smith (1931:131) to "N. India". In the massive folio work where these Indian turtle names appeared, two familiar turtle names were credited to the British herpetologist, Thomas Bell (1792–1880), as Gray cited an unpublished Bell manuscript (see Wheeler, 1998), and *Emys tectum*, current name- *Pangshura tectum* (Bell in: Gray, 1831), whose type specimens have not been located, with the type locality of the species simply given as "India".

John Gray's solo efforts resulted in a number of papers that described new turtle taxa. *Cyclemys mouhotii*-currentname- *Cuora mouhotii* (Gray, 1862), the original type series composed of BMNH 1947.3.4.27, 1947.3.4.48–49 and 1947.3.4.64–67 (seven syntypes), was described from "Lao Mountains, in Siam", restricted without explanation to "presumably the Luang Prabang mountain range on the border between Thailand and Laos" (also spelt Louang Phrabang, ca. 20° 00'N; 102° 30'–50'E, Luang Prabang Province, Laos) by King and Burke (1989). Fritz *et al.* (1998) designated BMNH 1947.3.4.27, as a lectotype, reiterating the type locality, as previously restricted, to "Luang Prabang, Laos, 19°54'N, 102°8'E". The species was, of course, named for Henri Mouhot (1826–1861), the French naturalist and explorer who collected reptiles in Thailand, Cambodia and Laos, and wrote an account of his travels "Voyages dans les royaumes de Siam, de Cambodge de Laos et autres parties centrales de l'Indo-Chine". Another Gray discovery was *Emys Hamiltonii*, current name- *Geoclemys hamiltonii* (Gray, 1830), based on the holotype, BMNH 1947.3.4.41 from "India", according to the BMNH register, although OUM 8477 is also labelled as a syntype. The namesake for this taxon is Dr. Francis Hamilton (1762–1829), aka Francis Buchanan, botanist and surgeon with the British East India Company based in Bengal and Burma. In the same volume, Gray described another geoemydid, *Emys Thurjii*, current name- *Hardella thurjii* (Gray, 1831), based on two syntypes (OUM 8433–34), from "India". Two other species described by Gray currently allocated to the genus *Pangshura*: *Emys tentoria*, current name- *Pangshura tentoria* (Gray, 1834), based on a holotype, BMNH 1947.3.4.72, from "Indiæ Orientalis regione Dukhun dictâ" (= the Deccan region of southern peninsular India), and was restricted to "Dhond, Poona Dist." (15°30'N; 75°04'E, Maharashtra State, west-central India) by Smith (1931:128), and *Batagur smithii*, current name- *Pangshura smithii* (Gray, 1863), was based on two syntypes (BMNH 1947.3.4.69–70), that were acquired from "North-western India: Punjab" and "River Chenab" (in Pakistan or north-western India), and named for Sir Andrew Smith (1797–1872), the Director-General of the Army Medical Board, and author of 'Illustrations of the zoology of South Africa'.

Softshell turtles appear to have been a favourite of John Gray, and he described a number of species worldwide (many currently in synonymy). The distinctive *Trionyx Hurum*, current name- *Nilssonina hurum* (Gray, 1830) was based on Buchanan Hamilton's drawings in the BMNH from "Indiæ fluvio Ganges", although the drawing bears the locality "Fatehgarh" (27°22'N; 79°38'E, Uttar Pradesh, northern India), to which the type locality was restricted by Smith (1931:171). Webb (1980a) emended the type locality to "Barrackpore (about 23 kilometers north Calcutta), West Bengal, India" (= Barakpur, 22°45'N; 88°20'E). A congener, *Trionyx Leithii*, currentname- *Nilssonina leithii* (Gray, 1872) was described on the basis of two syntypes, BMNH 1947.3.4.15 and 1947.3.6.7 from "Poonah" (= Pune, 18°34'N; 73°58'E, Maharashtra State, south-western India). Gray is also credited with the description of two remarkable trionychid turtles: *Trionyx indicus*, current name- *Chitra indica* (Gray in: Griffith and Pidgeon, 1831), which has been generally stated to be based on a colour plate in Gray (1831:Pl. 80), from "India, fl. Ganges, Penang" (the latter locality at present spelt Pulau Pinang, 05°30'N; 100°28'E, West Malaysia, in error), according to Gray (1831). However, Farkas (1994) demonstrated that a RCSM specimen

(from Penang), that was destroyed during World War II, was part of the original type series. The type locality was restricted to "Fatehgarh, Ganges" (27°22'N; 79°38'E, Uttar Pradesh, northern India) by Smith (1931:162). The second species, *Pelochelys cantorii* Gray, 1864, was based on two syntypes, BMNH 1947.3.6.21–22, from "Malacca" (= Melaka, 02°12'N; 102°15'E, West Malaysia). The last-mentioned species was named in honour of Theodore Edward Cantor (1809–1860), Danish surgeon-naturalist with the British East India Company, who collected and got illustrations of Indian reptiles sketched by local artists.

Gray's successor in the BMNH, Albert Carl Ludwig Gotthilf Günther (1830–1914) prepared a catalogue of the herpetofauna of an expanded British India, entitled "The reptiles of British India" that included the description of a new turtle, *Pangshura flaviventer* Günther, 1864, treated by some authorities as a subspecies of *Pangshura tentoria*, based on the holotype, BMNH 1947.3.4.82 (ex-BMNH 80.1.28.8); its type locality was not specified, but several turtles along with the holotype originated from "Bengal" (at present West Bengal State, eastern India, as well as Bangladesh). Günther, in turn, was succeeded by George Albert Boulenger (1858–1937), whose encyclopaedic knowledge of the world's herpetofauna is reflected in his voluminous publication record. A Boulenger tortoise name is *Testudo travancorica*, current name- *Indotestudo travancorica* (Boulenger, 1907), based on two syntypes, BMNH 1946.1.22.80–81 (a third syntype cannot be located at present), from "near Trivandrum" (on p: 560) (= Tiruvananthapuram, 08°30'N; 76°57'E, Kerala State, south-western India) and "...Travancore hills between 500 and 1,000 feet altitude, but not higher" (p. 560–561; the Travancore region is located in the southern Western Ghats, south of Palghat, 10°46'N; 76°39'E, Kerala State, south-western India). For some years, turtle biologists and others followed the opinion of Hoogmoed and Crumly (1984), in considering Schlegel and Müller's (1844) name, *Testudo forstenii*, as valid for the species from India's Western Ghats, arguing for an introduction of the Indian species into Sulawesi in eastern Indonesia, through human agencies.

Research on continental Europe too was active at the time. Prominent among them were the French, centred around MNHN. François-Marie Daudin (1774–1804), the author of a multi-volume series on the world's herpetofauna, entitled "Histoire naturelle, générale et particulière des reptiles" described *Testudo amboinensis*, current name- *Cuora amboinensis* (Daudin, 1801 "1802"). Daudin mentioned that the type was lost at sea before he saw it (see also Bour in Rummeler and Fritz, 1991:36) and wrote that the description of *Testudo amboinensis* was based on a manuscript by the French naturalist Claude-Antoine-Gaspard Riche (1762–1797), in the footnote on page 309, following the short description of the species. However, Bourret (1941:149), in his work on the turtles of Indo-China and adjacent areas, mentioned that the type was in MNHN (where it cannot be located at present). The type locality was given in the original description as "Amboine" (= Ambon, 03°41'S; 128°10'E, Maluku [Moluccas], Indonesia).

Printing presses flourished in Europe from the end of the 1700s, and many scholarly volumes appeared, with extensive colour plates, often distributed via subscription to the landed gentry as well as scholarly institutions of the time. One such work is 'Historia Testudinum iconibus illustrata', authored by Iohannes Davidis Schoepff (1752–1800), and published between the years 1792–1801, which described the now familiar Indian star tortoise, *Testudo elegans*, current name- *Geochelone elegans* (Schoepff, 1795). The holotype has not been traced, although Schoepff (1795) mentioned that the specimen on which the species was based was from Museis Hagae Comitibus et Harlemi (possibly TSMHN in Haarlem, the Netherlands), and came from "India orientali" (= eastern India). The date of publication of *Testudo elegans*, which was in part III of Schoepff's work is usually given as 1794. However, Ernst *et al.* (1994) showed that the third part was published in 1795. Petrus (also, Pieter) Boddaert (1730–1796), in a rarely-seen bilingual (Dutch and Latin) work, with an extremely long title (see reference) and typically shortened to 'Epistola' described the now familiar large south-east Asian trionychid turtle, *Testudo cartilaginea*, current name- *Amyda cartilaginea* (Boddaert, 1770); the holotype, originally at the Museo viri Celeberrimi Johannis Alberti Schlosseri, is at present MNHN 4150. No type locality was specified, and Baur (1893) subsequently restricted it to "Java" (in the Greater Sundas, Indonesia). Another French encyclopaedia, 'Tableau encyclopédique et méthodique des trois règnes de la nature. Erpétologie' by Pierre-Joseph Bonnaterre (1751–1804), described the familiar *Testudo punctata*, current name- *Lissemys punctata* (Bonnaterre, 1789) (Plate 1B), based on MNHN 7978 (ex-MNHN 819; holotype), from "Des grandes Indes" (= continental India), which was restricted to "Pondicherry, Coromandel Coast, India" (11°56'N; 79°53'E, on the south-east coast of India) by Webb (1980b). French nobleman, Baron Georges Jean-Léopold-Nicolas-Frédéric Dagobert Cuvier (1769–

1832), in his work on fossil vertebrates, described *Trionyx gangeticus*, current name- *Nilssonia gangetica* (Cuvier, 1825), on the basis of MNHN 9387 (ex-MNHN 799; lectotype designated by Bour *et al.*, 1995), from "Gange, Inde" (= River Ganga, northern India); MNHN 4148 (ex-MNHN 797; paralectotype), MNHN (AC) a.5226 (ex-MNHN V.130; paralectotype) and MNHN (AC) 1887.838 (ex-MNHN V.77; paralectotype).

Two other continental workers will be discussed here. August Friedrich Schweigger (1783–1821), in his monograph on the world's chelonians, entitled "Prodromus monographiae cheloniorum" described *Emys trijuga*, current name- *Melanochelys trijuga* (Schweigger, 1812). The holotype was in the MNHN, according to the original description, but cannot be traced at present. The type locality was given as "insula Java" (in the Greater Sundas, Indonesia; in error), the collector, French explorer and naturalist, Jean-Baptiste-Louis-Claude Théodore Leschenault de La Tour (1773–1826), having collected in both Java and India, presumably may have had the label of the holotype transposed with that of a Javanese specimen. The last turtle name to be discussed in this section is one created by René-Primevère Lesson (1794–1849) in a volume entitled "Centurie Zoologique, ou cloix d'A. maux rares, nouveaux ou imparfaitement connus". *Emys thermalis*, current name- *Melanochelys trijuga thermalis* (Lesson, 1830) (Plate 1C), whose types are untraced at present, acquired from "Ceylan" (= Sri Lanka), the species observed "...dans les eaux thermals de Cannia,.. Ceylan" (= living in the hot waters of Cannia [= Kanniya, 09°15'N; 80°41'E, near Trincomalee, Eastern Province], ... in Sri Lanka). This subspecies has since been reported from southern Peninsular India.

Colonial Period: India

Edward Blyth (1810–1873), was hired from England in 1840 as the first Curator of the Museum of the Asiatic Society of Bengal in Calcutta. Blyth's success in building up the museum through acquisition of specimens was largely through the establishment of contact with civil servants in far-flung parts of the British Empire, including Brian Houghton Hodgson (1800–1894), British diplomat and official Resident in Kathmandu, Nepal, Lieutenant-Colonel Sir Arthur Purves Phayre (1812–1885) in Burma; the Dutch-Ceylonese civil servant and naturalist, Edward Fredric Kelaart (1819–1860) in Ceylon; and the British administrator, Robert Francis Christopher Alexander Tytler (1818–1872) in the Andaman Islands. Three currently-valid names of Indian turtles and tortoises are credited to Blyth, including two testudinid species- *Testudo elongata*, current name- *Indotestudo elongata* (Blyth, 1853), based on four syntypes (ZSI 796 and ZSI 798–800), from "Arakan" (= Rakhine Yoma, a mountain range along coordinates ca. 21–18°N; 93–95°E, western Myanmar); *Testudo Phayrei*, current name- *Manouria emys phayrei* (Blyth, 1853), based in two syntypes (ZSI 813 and ZSI 15492), also from "Arakan", in addition to "Tenasserim Provinces" (= Taninthayi, ca. 12°05'N; 99°00'E, southern Myanmar) and the geoemydid, *Geomyda tricarinata*, current name- *Melanochelys tricarinata* (Blyth, 1856), which was described on the basis of a dried shell, ZSI 816 (holotype), from "Central India (Chaibása)" (= Chaibassa, 22°31'N; 85°50'E, Jharkhand State, eastern India).

Major Thomas Claverhill Jerdon (1811–1872), an authority on Indian mammals and birds, and a member of the Asiatic Society, collected extensively from the Himalayas and the Khasi Hills. His important herpetological publications include two papers that deal with his collections. The sole turtle species Jerdon described is *Pangshura Sylhetensis*, current name combination unaltered, except for Jerdon's usage of upper case 'S' for the species nomen- *Pangshura sylhetensis* Jerdon, 1870, based on three syntypes, BMNH 1947.3.4.22 and BMNH 1947.3.4.62–63, from "Terria Ghat at the foot of the Khasi hills" (unlocated in the maps and gazetteers consulted, presumably in Sylhet District, Bangladesh, where several localities named Tori Ghat [= passenger country boat stations] exist).

John Anderson (1833–1900), who replaced Blyth after the natural history collection of the Museum of the Asiatic Society of Bengal was transferred to the newly established Indian Museum, was the first Supervisor of the Museum. An Indian softshell turtle species described by Anderson is *Trionyx nigricans*, current name- *Nilssonia nigricans* (Anderson, 1875), based on material from "Chittagong, Bengal" (22°20'N; 91°48'E, Chittagong District, south-eastern Bangladesh). The two syntypes, ZSI 664 and 1898, are extant at present. Long considered to be restricted to a single pond attached to a shrine in Chittagong, south-eastern Bangladesh, it has, in recent years,

been found widespread in north-eastern India. Anderson took part in the two Yunnan Expeditions (1868–69 and 1874–75), and produced a fine work in 1878 (published in 1879) entitled 'Anatomical and zoological researches: comprising an account of the zoological results of the two expeditions to western Yunnan in 1868 and 1875; and a monograph of the two cetacean genera, *Platanista* and *Orcella*', which was a monograph on the vertebrate fauna of the Upper Burma-Yunnan region and included a review of freshwater turtles of India and adjacent regions of south-east Asia. Anderson described two geoemydid turtles, *Emys trijuga* var. *Coronata*, current name- *Melanochelys trijuga coronata* (Anderson, "1878" 1879), based on the holotype, ZSI 1012, from "Travancore" (southern Western Ghats, south of Palghat, 10°46'N; 76°39'E, Kerala State, south-western India) and *Batagur (Morenia) petersi*, current name- *Morenia petersi* (Anderson, "1878" 1879) (Plate 1D), based on three syntypes (ZSI 155–156 and ZMB 8865), that were purchased in a "Calcutta bazaar", the type series originating from "Huzurapur in the Jessore District" (unlocated), Furreedpore (= Faridpur, 23°29'N; 89°31'E, Faridpur District) and "Dacca" (= Dhaka, 23°42'N; 90°22'E, Dhaka District), Bangladesh. The species was named for Wilhelm Carl Hartweg Peters (1815–1883), Curator of the ZMB.

Thomas Nelson Annandale (1876–1924), joined the Indian Museum as Deputy Superintendent and is credited with the establishment of the Zoological Survey of India in 1916. Although primarily an ecologist and limnologist, conducting extensive work on the ecology of Asian lakes, Annandale described several new herpetological taxa, including the turtle, *Geoemyda indopeninsularis*, current name- *Melanochelys trijuga indopeninsularis* (Annandale, 1913), based on two syntypes (ZSI 17098 and 17100 from "Singhbhum district of Chota Nagpur" (ca. 22°30'N; 85°30'E, Orissa State, eastern India) and one (in error) from "Dharwar district...southern part of the Bombay Presidency" (ca. 18°28'N; 74°38'E, Maharashtra State, western India).

A collector of the Indian Museum, Calcutta, acquired the holotype (ZSI 17117) of the enigmatic geoemydid, *Geoemyda silvatica*, current name, *Vijayachelys silvatica* (Henderson, 1912), from "Near Kavalai in the Cochin State Forest...at an elevation of about 1500 feet above sea level" (10°06'–23'N; 76°09'–53'E, Thrissur District, Kerala State, south-western India). Henderson (1912) also examined a juvenile from the same area, but it was not made part of the type series, and no descriptions were provided.

Post-colonial Period

Paulus Edward Pieris Deraniyagala (1900–1973), Director of the National Museum, Colombo published an important account on the crocodilians and turtles of Sri Lanka, entitled 'The tetrapod reptiles of Ceylon. Vol. 1', published in 1939, as well as a two volume set in the 'Colored Atlas' series (Vol. 2: Tetrapod reptiles, including crocodilians, turtles and lizards; and Vol. 3: Snakes), between 1953–1955. Deraniyagala described 51 taxa of reptiles, both living and fossil. Deraniyagala (1933) described a subspecies of *Caretta caretta* from Sri Lanka, which he named *gigas*, based on a shell (BMNH 1947.3.5.76) and cranium (BMNH 1946.1.22.64; ex-BMNH 1934.5.1.1), from "Ceylon". The illustration in the original description is of a mounted specimen in the Colombo Museum, which should also be part of the type series, which need to be treated as syntypes. It is assumed that this subspecies name applies to the adjacent Indian populations.

Western contributors to the knowledge on Indian turtles continued well into the period post independence, and into modern times. Robert Friedrich Wilhelm Mertens (1894–1975) from Senckenberg Museum, Frankfurt am Main, Germany, conducted extensive field work in Pakistan on herpetofaunal diversity, describing numerous new species. A new turtle described from northern India by Mertens is *Kachuga tecta circumdata*, current name- *Pangsuria tentoria circumdata* (Mertens, 1969), based on SMF 52793 (holotype) and SMF 47847 (paratype), from "Meerut, Indien" (= Meerut, 29°00'N; 77°42'E, Uttar Pradesh, northern India); SMF 51067 (paratype), SMF 51569–71 (three paratypes), "Gebiet von Calcutta, Indien" (= vicinity of Kolkata, ca. 22°30'N; 88°20'E, West Bengal State, eastern India); SMF 58084 (paratype), "Calcutta"; SMF 61209 (paratype), "200 km nordwestlich Calcutta" (= 200 km north-west of Kolkata, possibly around the Jharkhand-West Bengal border, eastern India, at coordinates ca. 23°47'N; 86°32'E); SMF 65292 (paratype), without data; in addition, the location of two paratypes, that were alive at the time of description, are at present unknown.



During the course of his investigations on the systematics and nomenclature of the ubiquitous Indian "mud" turtle (genus *Lissemys*), Robert Graven Webb (1927–), then Professor at the University of Texas at El Paso, USA, noticed that incorrect subspecies names were being applied, the unspotted peninsular Indian (and Sri Lankan) *granosa* representing the type of the species *Lissemys punctata*, which, strangely, left the equally common northern subspecies nameless. Webb then supplied a name for this form, *Lissemys punctata andersoni* Webb, 1980, based on the holotype, MNHN 1977.1986 from "Belbari, Terai, south-eastern Nepal, elevation 210 m" (ca. 26°33'N; 87°43'E, near Haraincha, Kosi Province), and named after John Anderson (1833–1900), Superintendent of the IMRR.

A significant joint US-Indian research project, headed by Edward Owen Moll (1939–) was conducted for India's freshwater turtles in the early-1980s. One of the new taxon described was *Kachuga smithii pallidipes*, current name- *Pangshura smithii pallidipes* (Moll, 1987), comprising FMNH 224177 (holotype), from "Gandak River, Bherihari Wildlife Sanctuary, Bettiah (West Champaran) District, Bihar" (26°48'N; 84°30'E, northern India); USNM 257778 (paratype), "Karnali River, Royal Bardia Wildlife Reserve, 2 km N. Thakurdara, Nepal" (28°11'N; 81°31'E); and FMNH 224186 (paratype), "Ghagra River, near Kailaspuri at Girija Barrage, Bahraich District, Uttar Pradesh" (Ghagra River mouth at coordinates 23°17'N; 84°33'E, in northern India). A second subspecific nomen relevant to Indian turtles was occupied in the course of a revision of *Cuora amboinensis*: *Cuora amboinensis kamaroma* Rummel and Fritz, 1991, derived from Thai material (ZMH-R 00277 [holotype], "circa 50 km nördlich von Bangkok, Thailand" [= about 50 km north of Bangkok, 13°45'N; 100°31'E, Phra Nakhon Province, Thailand]; MNHN 2032: 1–2 [two paratypes], "Bangkok"; RMNH 14902: 1–2 (two paratypes), "Bangkok"; SMF 64641, "Bangkok"; SMF 68190 (paratype), "Bangkok"; SMNS 5480 (paratype), "Bangkok"; SMNS 5484: 1–2 (two paratypes), "Bangkok"; SMNS 7493 (paratype), "Bangkok"; ZMH-R 00276 (paratype), "circa 50 km nördlich von Bangkok, Thailand"; ZMH-R 00278 (paratype), "circa 50 km nördlich von Bangkok, Thailand". The most-recent Indian turtle to be described is *Cyclemys gemeli* Fritz *et al.* (2008), from "...street from Tezpur to Arunachal Pradesh, 5 km to border of Arunachal Pradesh, Jia Bhoroli River Region, Assam, India", based on NMW 37153 (holotype).

Among higher level turtle taxon names created in recent years is the geoemydid turtle genus, *Vijayachelys* Praschag, Schmidt, Frittsch, Müller, Gemel and Fritz, 2006, type species: *Geoemyda silvatica* Henderson, 1912, monotypy and designation. It was named in honour of Jagannathan Vijaya (1959–1987), turtle biologist with the Madras Snake Park Trust and the Madras Crocodile Bank Trust, who spent several months living in a cave to study the biology of this species.

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Appendix I

Abbreviations of systematic institutions mentioned in the text are listed below. Where available (marked with an asterisk), abbreviations follow Leviton *et al.* (1985) and Leviton *et al.* (1988).

- The Natural History Museum, London (formerly, British Museum of Natural History), U.K. (BMNH*)
- National Museum, Colombo, Sri Lanka (CMS*)
- Field Museum of Natural History, Chicago, U.S.A. (FMNH*)
- Indian Museum Reptile Registry, Calcutta, India (IMRR*; now accessioned in the collection of the ZSI)
- Musée National d'Histoire Naturelle, Paris, France (MNHN*)
- Zoological Museum, Estonia, Russia (MZT*)
- Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRM*)
- Naturhistorisches Museum Wien, Vienna, Austria (NMW*)
- Oxford University Museum, Oxford, U.K. (OUM*)
- Royal College of Surgeons, London, U.K. (RCSM)
- Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Histoire), Leiden, The Netherlands (RMNH*)
- Natur-Museum und Forschungs-institut Senckenberg, Frankfurt am Main, Germany (SMF*)
- Staatliches Museum für Naturkunde, Stuttgart, Germany (SMNS*)
- Teylers Strichtina Museum, Haarlem, the Netherlands (TSMHN*)
- National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. (USNM*)
- Zoologisches Museum Humboldt-Universität, Berlin, Germany (ZMB*)
- Zoologisches Institut und Museum, Universität Hamburg, Hamburg, Germany (ZMH*)
- Museo Zoologico, Istituto di Zoologia, Zoologia Comparativo e Genetico, Università di Padova, Italy (ZMUP*)
- Zoologiska Museet, Uppsala Universitet, Uppsala, Sweden (ZMUU*)
- Zoological Survey of India, National Zoological Collection, Kolkata, India (ZSI*)



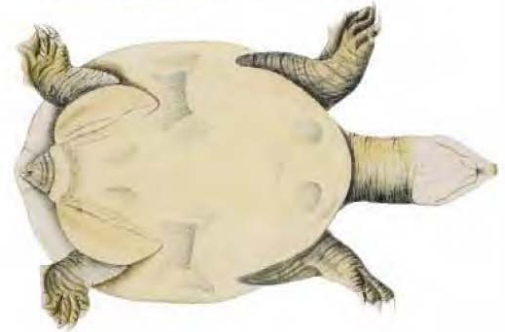
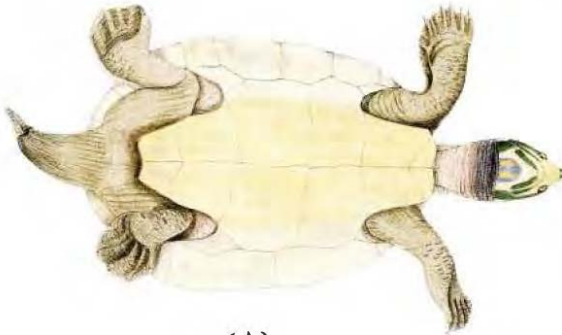
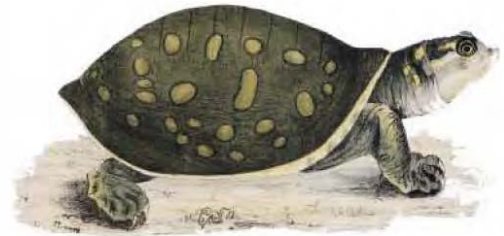
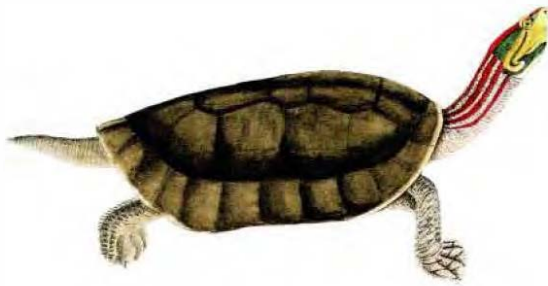
Appendix II

Etymology of Indian Turtle Names.

Sl	Nomen	Translation
	CHELONIIDAE	
1	<i>Caretta</i>	Spanish for scutes (of turtles)
2	<i>Caretta</i>	As for genus
3	<i>Gigas</i>	Latin for large
4	<i>Chelonia</i>	Greek for turtle
5	<i>Mydas</i>	Greek for wet
6	<i>Eretmochelys</i>	Greek for oar-turtle, an allusion to the oar-like fore limbs
7	<i>Imbricata</i>	Latin for imbricate, for the imbricate (or overlapping) scales on all except old turtles
8	<i>Lepidochelys</i>	Greek for scute turtle, an allusion to the large number of carapace scutes
9	<i>olivacea</i>	Latin for olive, for the carapace colouration
	DERMOCHELYIDAE	
10	<i>Dermochelys</i>	Greek for leather turtle
11	<i>coriaca</i>	Latin for leathery, for the leathery shell
	GEOEMYDIDAE	
12	<i>Batagur</i>	Apparently one of the meaningless names created by John Gray
13	<i>baska</i>	Latin for bewitching
14	<i>dhongoka</i>	Apparently from the Hindi vernacular for the species
15	<i>kachuga</i>	Hindi vernacular for the species
16	<i>Cuora</i>	From the Malay <i>Kura</i> , meaning hard-shelled turtle
17	<i>amboinensis</i>	Latin implying inhabitant of Amboina (Ambon), Maluku, Indonesia
18	<i>kamaroma</i>	Greek for arched, for the high domed shell
19	<i>mouhotii</i>	For Henri Mouhot (1826–1861), naturalist and explorer who collected reptiles in Thailand, Cambodia and Laos
20	<i>Cyclemys</i>	Greek for circle turtle, for the rounded shell
21	<i>Cyclemys gemeli</i>	For Richard Gemel (1948–), Austrian herpetologist
22	<i>Geoclemys</i>	Latin for earth turtle
23	<i>hamiltonii</i>	For Dr. Francis Hamilton (1762–1829), botanist and surgeon with the British East India Company based in Bengal and Burma
24	<i>Hardella</i>	Apparently one of the meaningless names created by John Gray
25	<i>thurjii</i>	Apparently one of the meaningless names created by John Gray
26	<i>Melanochelys</i>	Greek for black turtle
27	<i>tricarinata</i>	Latin for three keeled
28	<i>trijuga</i>	Latin for three-ridged
29	<i>coronata</i>	Latin for crowned
30	<i>indopeninsularis</i>	Latin for inhabitant of the Indian peninsular
31	<i>parkeri</i>	For Hampton Wildman Parker (1897–1968) of the BMNH
32	<i>thermalis</i>	Latin for heat
33	<i>Morenia</i>	Greek for sluggishness
34	<i>petersi</i>	For Wilhelm Carl Hartweg Peters (1815–1883) of ZMB
35	<i>Pangshura</i>	Apparently one of the meaningless names created by John Gray
36	<i>smithii</i>	For Sir Andrew Smith (1797–1872), Director-General of Army Medical Board, and author of 'Illustrations of the zoology of South Africa'
37	<i>pallidipes</i>	Latin for pale-footed

38	<i>sylhetensis</i>	Latin implying an inhabitant of Sylhet
39	<i>tectum</i>	Latin for roofed
40	<i>tentoria</i>	Latin for extended, for the elevated shell
41	<i>circumdata</i>	for surrounding, for the pinkish-orange pleuro-marginal ring
42	<i>flaviventer</i>	Latin for yellow-bellied
43	<i>Vijayachelys</i>	For Jagannathan Vijaya (1959–1987), turtle biologist with the Madras Snake Park Trust; chelys, Greek for turtle
44	<i>silvatica</i>	Latin for forest-dweller
	TESTUDINIDAE	
45	<i>Geochelone</i>	Greek for earth turtle
46	<i>elegans</i>	Latin for elegant
47	<i>Indotestudo</i>	Greek for Indian tortoise
48	<i>elongata</i>	Latin for elongated
49	<i>travancorica</i>	Pertaining to Travancore, Kerala
50	<i>Manouria</i>	Greek for rare, domed
51	<i>emys</i>	Greek for turtle
52	<i>phayrei</i>	For Lieutenant-Colonel Sir Arthur Purves Phayre (1812–1885), British Commissioner at Pegu, Burma and Chief Commissioner of British Burma
	TRIONYCHIDAE	
53	<i>Amyda</i>	Greek for turtle
54	<i>cartilaginea</i>	Latin for cartilage
55	<i>Chitra</i>	After the north Indian vernacular, meaning picture
56	<i>indica</i>	Latin for pertaining to India
57	<i>Lissemys</i>	Greek for smooth turtle
58	<i>punctata</i>	Latin for spotted
59	<i>andersoni</i>	For John Anderson (1833–1900), Superintendent of the IMRR
60	<i>Nilssonia</i>	For Sven Nilsson (1787–1883), Professor of Natural History at Lund
61	<i>gangetica</i>	Latin for pertaining to the River Ganga
62	<i>hurum</i>	Apparently derived from a north Indian vernacular for the species
63	<i>leithii</i>	For Dr. Andrew Leith Adams (1827–1882), who collected plants and animals between 1840–1857
64	<i>nigricans</i>	Latin for blackish
65	<i>Pelochelys</i>	Greek for mud turtle
66	<i>cantorii</i>	For Theodore Edward Cantor (1809–1860), Danish surgeon-naturalist with the British East India Company

Plate 1



(A)

(B)



(C)

(D)

Images of Indian turtles from early published works. (A): *Emys kachuga* from Gray's (1831) 'Illustrations of Indian Zoology'; (B): *Testudo punctata* from Gray's (1831) 'Illustrations of Indian Zoology'. (C): *Emys thermalis* from Lesson's (1830) 'Centurie Zoologique, ou cloix d'A. maux rares, nouveaux ou imparfaitement connus' and (D): *Batagur (Morenia) petersi* from Anderson's ("1878" 1879) 'Anatomical and zoological researches: comprising an account of the zoological results of the two expeditions to western Yunnan in 1868 and 1875; and a monograph of the two cetacean genera, *Platanista* and *Orcella*'.

Chapter 02

The Turtle Collection of the Zoological Survey of India, Kolkata, India

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The foundation (in 1784) of the Asiatic Society of Bengal at Calcutta, then capital of British India by Sir William Jones (1746–1796) was a significant step towards the establishment of systematic research in zoology and the exploration of natural diversity of India and adjacent countries. It is thus to early European naturalists that we are indebted for commencing scientific research on the biodiversity of a subcontinent, which is both diverse and abundant. Often at great personal risk, these pioneers traveled extensively to what must have been inaccessible regions, returning often with spectacular specimens for the Society's Museum. The early exploration phase in the Indian region started in the early 1800s and lasted till the end of that century, when many species of Indian turtles were described. The large (and eclectic) membership of the Society was responsible for the arrival of both palaeontological and zoological material to the museum of the aforementioned Society, from all over British India, and occasionally, beyond, including the Middle East, Africa, North America, Central Asia, the Malayan Peninsula and Archipelago and eastern China, especially after 1824.

In 1866, with the passing of the Indian Museum Act, this collection was handed over to the Indian Museum (Fermor, 1836), and with the establishment of the Zoological Survey of India (ZSI) in 1916, the zoological collections were passed on to this organization, which included a large number of turtle specimens, both wet and dry. The ZSI, with its headquarters at Kolkata, is the single largest repository of zoological material in the country. The collection of turtles was made by often prominent naturalists of the time, being either gifts from the members of the Asiatic Society or collected by the staff of the Society, or the ZSI (Plate 2A–2D) during scientific expeditions, such as to Yarkand, Yunnan, Chilka Lake, Little Andaman, Great Nicobar, Chotanagpur, *etc.* Specimens were also received from museums such as Berlin, London, Karachi and Port Louis, via exchanges or as donations. Notable collectors of herpetological (including turtle) material include: John Anderson (1833–1900), Thomas Nelson Annandale (1876–1924), William Thomas Blanford (1832–1905), Banawari Lal Choudhuri (?–1913), John Cockburn (?–?), George Edward Dobson (1848–1895), Ashley Eden (1831–1887), Henry Haversham Godwin-Austen (1834–1923), John Robert Henderson (1863–1925), Baini Prashad (1894–1969), Edward Bosc Sladen (1831–1890), Ferdinand Stoliczka (1838–1874) and William Theobald (1829–1908).

This essay presents a listing of the contents of the turtle collection in the Zoological Survey of India, Kolkata (i.e., the National Zoological Collection). Plate 2E and 2F show representatives of turtle types in the ZSI, which are preserved in a custom-built fire-proof building, behind the Indian Museum building, at 16-Jawaharlal Nehru Road. Other important turtle collections in the 16 regional stations of the Survey have not been included, and neither are the palaeontological material of turtles from mostly the North Indian Shiwaliks and also some Jurassic and Eocene turtle material of the Asiatic Society of Bengal and the Geological Survey of India, that are currently stored in the adjacent Indian Museum or Geological Survey of India buildings. The term 'turtle' includes members of the Order Testudines (Chelonia or Chelonii, of some authors). Nomenclature follows Fritz and Havas (2007). The geographical spread of the samples include, besides general localities (such as 'Atlantic Ocean' or 'Arabia', or those received without data from zoos and museums), Afghanistan, Bangladesh, China, Eritrea, India, Indonesia, Iran, Iraq, Japan, Madagascar, Malaysia, Mauritius, Myanmar, Palestine, Pakistan, Seychelles, South Africa, Sri Lanka, Thailand and the U.S.A.



Table-1 presents a list of turtles from the general collection (= non-types); **Table-2** lists turtle types present in the collection (updated from the listing in Das *et al.*, 1998). Abbreviations include: C = central; E = east; km = kilometer; mi = mile; N = north; NE = north-east; nr = near; NW = north-west; PWD = Public Works Department; S = south; SE = south-east and W = west. Contemporary locality names have been used, as far as possible.

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Table-1: List of general (= non-type) collections of turtles currently present in the ZSI, Kolkata.

S. No	Systematic List	Locality (number of specimens)	Reg. No.
Family: Dermochelyidae			
1	<i>Dermochelys coriacea</i> (Vandelli, 1761)	Myanmar: Tenasserim (1)	ZSI 887
Family: Cheloniidae			
2	<i>Caretta caretta</i> (Linnaeus, 1758)	Atlantic Ocean (2)	ZSI, 387, 3858,
3	<i>Chelonia mydas</i> (Linnaeus, 1758)	India: Bay of Bengal (1); SE Satpura Peninsula Channel, Orissa (1); Galathea Bay, Great Nicobar (1); Andamans (1); Myanmar: Yangon (2); Kyaikkami (1); Thamihla Kyun (1); Atlantic Ocean (1)	ZSI 22489, 307, 308, 310, 3881, 295, 18989, 363, 389,
4	<i>Eretmochelys imbricata</i> (Linnaeus, 1766)	India: Andamans (1); Andaman Island (1); Konamic, Little Andaman (1); Campbell Bay, Great Nicobar (2); Thailand: Bangkok (1); Atlantic Ocean (1)	ZSI 316, 386, 14705, 1768, 20924, 22488, 23425
5	<i>Lepidochelys olivacea</i> (Eschscholtz, 1829)	India: Chandbali Coast, Balasore District, Orissa (2); Gahirmatha Beach, Orissa (1); Digba, District Midnapore, West Bengal (1); Vishakapatnam, Andhra Pradesh (1); Trivandrum Beach, Kerala (3); nr. PWD Jetty, Mayabandar, North Andaman (1)	ZSI 23972, 23982, 24134, 24536, 24713, 24972, 13568, 13567, 13569,
Family: Bataguridae			
6	<i>Batagur dhongoka</i> (Gray, 1832)	India: River Ganga, Rajmahal, Jharkhand (10); Santhal Parganas District, Jharkhand (1); Oodhuna, nr. Rajmahal, Jharkhand (2); Titeghar, West Bengal (1); Sagar, Sagar District, Madhya Pradesh (1); Agra, Uttar Pradesh (2); Allahabad, Uttar Pradesh (4); Sonarpur, Assam (2)	ZSI 20643, 16789, 20635, 20636, 20637, 20638, 20639, 20640, 20641, 20642, 1445, 18984, 858, 194, 197, 473, 501, 502, 1889, 20450, 17433, 17099, 18319, 18320,
7	<i>Batagur kachuga</i> (Gray, 1831)	India: Firozpur, Punjab (2); Kolkata, West Bengal (1); River Hooghly, Kolkata, West Bengal (1); Purnia, Bihar (1); River Ganga, Rajmahal, Jharkhand (3); Rajmahal, Jharkhand (1); Bhagalpur, Bihar (1); Lucknow, Uttar Pradesh (1); Pakistan: Lahore (1)	ZSI 17607, 10610, 16792, 202, 1438, 20632, 20630, 20634, 16778, 23005, 23743, 846
8	<i>Cuora amboinensis</i> (Daudin, 1801)	India: Great Nicobar (1); Mazbat, Mangaldai, N of River Brahmaputra, Assam (1); Ajiam (unlocated) (1); Malaysia (2); Myanmar: Myanmar (4); Tenasserim (1)	ZSI 14712, 16690, 817, 818, 819, 928, 993, 13350, 1344.
9	<i>Cuora mouhotii</i> (Gray, 1862)	India: Garo Hills, Meghalaya (5); Assam (1); Deban, 27 km E of Miao, Tirap District, Arunachal Pradesh (1); Myanmar: Myanmar (1)	ZSI 14, 708, 709, 913, 914, 1484, 1016, 23923
10	<i>Cyclemys dentata</i> (Gray, 1831) species complex	India: Tura, Garo Hills, Meghalaya (1); 3.5 mi Calin, Tura, Garo Hills, Meghalaya (1); 3.5 mi Bebo, Tura, foot of Garo Hills, Meghalaya (1); Narayanpur Tea Estate, Cachar, Assam (1); Sibsagar, Assam (1); Jaronti River, W. Doars, West Bengal (1); unknown, listed as from "Calcutta, West Bengal" (1); Myanmar: Myanmar (9); He Ho Plains, S. Shan State (1); Sattam Chaung Stream, Mitkyina District (1); Inle-Lake, South Shan State (1); He-Hah, S. Shan State (1); Fort Steadman, Inle Lake, S. Shan States (1); Sittwe (1); Rakhine Yoma (2); Tenasserim, Myanmar	ZSI 760, 775, 18568, 19235, 20023, 20449, 1320, 132, 1327, 18593, 1328, 1329, 1330, 18482, 1332, 18593, 18594, 13, 410, 12603, 18482, 820, 821, 994, 1356, 335
11	<i>Geoclemys hamiltonii</i> (Gray, 1831)	Bangladesh: Jessore (2); India: River Matlah, West Bengal (2); Zoological Gardens, Kolkata, West Bengal (1); Kolkata, West Bengal (12); Hosiarpur, Punjab (1); Firozpur, Punjab (1); Kaziranga National Park, Golaghat District, Assam (5); Sonarpur, Kamrup, Assam (1)	ZSI 103, 104, 3863, 101, 102, 71, 73, 84, 65, 89, 96, 97, 99, 100, 1410, 1412, 1411, 1632, 20570, 18339, 17611, 24755, 24706, 24707, 24708, 24709



12	<i>Hardella thurjii</i> (Gray, 1831)	Bangladesh: Jessore (1); Dhaka (1); India: Oodhuna nr. Rajmahal, Jharkhand (1); River Ganga at Rajmahal, Jharkhand (4); Purnia District, Bihar (4); Rajmahal, Bihar (1); Kolassy, Purnea District, Jharkhand (1); Siripur, Saran, Bihar (1); Shillong, Meghalaya (1); Kolkata, West Bengal (11); Kolkata, West Bengal (2); Allahabad, Uttar Pradesh (2)	16776, 2337, 843, 849, 853, 854, 855, 74, 75, 78, 79, 80, 135, 448, 20644, 20645, 20646, 20647, 1424, 1426, 1435, 1427, 1500, 16776, 17436, 105, 1428, 1480, 1431.
13	<i>Heosemys annandalii</i> (Boulenger, 1903)	Thailand (1)	ZSI 18914
14	<i>Heosemys depressa</i> (Anderson, 1875)	Myanmar: Myanmar (1); Rakhine (2)	ZSI 490, 1176, 1332
15	<i>Heosemys grandis</i> Gray (Gray, 1860)	Myanmar: Myanmar (19); Rakhine (1); also, 'Enoshima, Japan' (erroneous data) (1)	ZSI 916, 918, 920, 921, 922, 1310, 1315, 1316, 1490, 923, 1309, 1311, 1317, 699, 917, 926, 927, 710, 729, 815, 13008
16	<i>Heosemys spinosa</i> (Gray, 1830)	Malaysia: Sarawak (1)	ZSI 11693
17	<i>Malayemys subtrijuga</i> (Schlegel and Müller, 1845)	Indonesia: Java (3); Thailand: Songkhla (1); Lampan, Phatthalung (2)	ZSI 824, 825, 826, 18041, 18025, 18027
18	<i>Melanochelys tricarinata</i> (Blyth, 1856)	India: Baradighi Tea Estate, Jalpaiguri District, West Bengal (2); Teesta Bazar, Teesta Valley, West Bengal (1); Budhram, Kalipur Forest, Gorumara National Park, West Bengal (1); N Brahmaputra, Assam (1); Sonarpur, Assam (1); Daffa Hills, Arunachal Pradesh (1); Chotanagpur, Jharkhand (1); Munguraha forest, West Champaran District, Bihar (1)	ZSI 18043, 20448, 18042, 18329, 18391, 1017, 1324, 25131, 25299
19	<i>Melanochelys trijuga coronata</i> (Anderson, 1879)	India: Cannore District, Kerala (1); Chalakudi, Cochin, Kerala (1); 25 km NE of Calicut, Kerala (1)	ZSI 23946, 17018, 17437
20	<i>Melanochelys trijuga edeniana</i> Theobald, 1876	Myanmar: Myanmar (3)	ZSI 550, 930, 20445
21	<i>Melanochelys trijuga indopeninsularis</i> (Annandale, 1913)	India: Baradighi Tea Estate, Jalpaiguri District, West Bengal (1)	ZSI 17991
22	<i>Melanochelys trijuga thermalis</i> (Lesson, 1830)	Sri Lanka: Sri Lanka (57)	ZSI 33, 35, 36, 39, 54, 55, 56, 57, 58, 59, 60, 62, 63, 64, 65, 66, 26, 27, 28, 30, 1357, 1358, 1361, 1362, 1363, 933, 1358, 1360, 1359, 1361, 1384, 1388, 1389, 1390, 1399, 1401, 1400, 1402, 1382, 1395, 1404, 1385, 1389, 1638, 1639, 1357, 1362, 1363, 1403, 1638, 37, 19, 67, 68, 22, 2589, 1348
23	<i>Melanochelys trijuga triuga</i> (Schweigger, 1812)	India: Dhavan Village, 8 km E of Forest Rest House, Valpoi, Goa (1); Chandi Village, 64 km from Ponda, Goa (1); Nagare River, Valpoi, Goa (1); Canacona, Goa (1); Chennai, Tamil Nadu (2); Kargudi, Nilgiris, Tamil Nadu (3)	ZSI 22009, 22010, 22008, 16722, 17434, 21926, 16723, 17434, 23351
24	<i>Pangshura smithii</i> (Gray, 1863)	Bangladesh: Rajshahi (1); India: Agra, Uttar Pradesh (1); Allahabad, Uttar Pradesh (12); Oodhuna, Rajmahal, Jharkhand (3); Firozpur, Punjab (1); Pakistan: Lahore (1)	ZSI 3867, 3868, 451-463, 471, 472, 200, 15848, 16773, 16774, 16775, 16788, 17606, 1476,
25	<i>Pangshura sylhetensis</i> (Jerdon, 1870)	Bangladesh: Mairimekh, Chittagong Hill Tract (1); India: Cachar, Assam (1); Garo Hills, Meghalaya (1); Nameri, Seijusa, East Kameng District, Arunachal Pradesh (1); Aijam (unlocated) (1); Naga Hills, Nagaland (1); Budhram, Kalipur Forest, Gorumara National Park, West Bengal	ZSI 110, 3923, 24647, 954, 955, 956, 19240, 25130

26	<i>Pangshura tectum</i> (Gray, 1830)	Bangladesh: village nr. Heal Hoon, Moulvi Bazar District (1); India: NW of Agra, Uttar Pradesh (6); Agra, Uttar Pradesh (1); Allahabad, Uttar Pradesh (3); Makhua, Firozpur, Punjab (1); Kolkata, West Bengal (10); Baradighi Tea Estate, Jalpaiguri District, West Bengal (1); Palta, 24 Parganas, West Bengal (1); branch of River Taur, N of Magwal Village, Jammu District, Jammu and Kashmir (1); Cherrapunji, Meghalaya (1); Delong, Abor Hills, Arunachal Pradesh (1); Seonath River, Bilaspur, Chhatisgarh (1); Bhopal, Madhya Pradesh (1)	ZSI 116-121, 147, 149-152, 164, 868, 466, 492, 493, 17609, 18015, 19236, 171, 172-174, 1477, 22964, 21672, 16909, 17775, 24258, 24752
27	<i>Pangshura tentoria</i> (Gray, 1834)	India: Cuttack, Orissa (2); Tikarpara, Dhenkanal District, Orissa (3); River Mahanadi, Cuttack, Orissa (4); Kaziranga National Park, Golaghat District, Assam (1); Gobrai, Kaziranga National Park, District Golaghat, Assam (3)	ZSI 16782, 16793, 16794, 16767, 16768, 16771, 24710, 24131, 24132, 24133, 525, 24710, 24711, 24712
28	<i>Morenia petersi</i> (Anderson, 1879)	Bangladesh: Faridpur (2); Noakhali (1) India: N Brahmaputra, Assam (1); Kolkata, West Bengal (3)	ZSI 155, 156, 18335, 865, 866, 867, 17435
29	<i>Morenia ocellata</i> (Duméril and Bibron, 1835)	Myanmar: Myanmar (20); Bago, S Myanmar (6) Sittwe (4)	ZSI 940, 941, 950, 951, 1468, 1469, 1470, 1488, 1473, 935, 939, 180, 185, 191, 199, 203, 206, 207, 208, 211, 859, 861, 860, 862, 863, 864, 178, 179, 1601, 946
30	<i>Notochelys platynota</i> (Gray, 1834)	Myanmar: Myanmar (3)	ZSI 1021, 1323, 1326
31	<i>Orlitia borneensis</i> Gray, 1873	Malaysia: Pulau Pinang (1)	ZSI 764
32	<i>Siebenrockiella crassicolis</i> (Gray, 1831)	Malaysia: Pulau Pinang (2); Thailand: Songkhla (2); Lungpung, Phatthalung (2)	ZSI 3862, 764, 18023, 18024, 18039, 18040, 567, 639, 640, 1378
33	<i>Vijayachelys silvatica</i> (Henderson, 1912)	India: Cochin, Kerala (1)	ZSI 17115
Family: Emydidae			
34	<i>Clemmys guttata</i> (Schneider, 1792)	"North America" (2)	ZSI 395, 397
35	<i>Emys orbicularis</i> (Linnaeus, 1758)	Unlocated: Engelson, Caspian Sea (2); no data (donor: Berlin Museum) (1)	ZSI 302, 978.485
36	<i>Mauremys caspica</i> (Gmelin, 1774)	Iran: N Iran (4); Caspian Sea (1); Iraq: Euphrates River at Nasariyeh (5)	ZSI 296, 297, 298, 299, 505, 19238, 18894.18892, 18893, 18894
37	<i>Mauremys japonica</i> (Temminck and Schlegel, 1835)	Japan: Japan (1)	ZSI 1418
38	<i>Mauremys rivulata</i> (Valenciennes, 1833)	Israel: Sea of Galilee (4); Palestine: W of Essemakh Lake (2)	ZSI 11349, 11350, 11351, 11352,
39	<i>Trachemys scripta</i> (Schoepff, 1792)	U.S.A.: Charleston, South Carolina (1); also, North America (2)	ZSI 418, 444, 3860
Family: Pelomedusidae			
40	<i>Pelomedusa subrufa</i> (Lacépède, 1788)	Eritrea: Anseba Valley (2)	ZSI 314, 315
Family: Platysternidae			
41	<i>Platysternon megacephalum</i> Gray, 1831	Myanmar: Mottama, Mon State (1); Tounghoo, Sittoung (1); Down Hills (unlocated) (1)	ZSI 873, 205, 16040, 16720
Family: Testudinidae			
42	<i>Aldabrachelys gigantea</i> (Schweigger, 1812)	Seychelles: Aldabra Atoll (1)	ZSI 25869



43	<i>Astrochelys radiata</i> (Shaw, 1802)	South Africa: South Africa (1); Madagascar: Madagascar (1)	ZSI 804, 15487
44	<i>Chersina angulata</i> (Schweigger, 1812)	South Africa: South Africa (1)	ZSI 808
45	<i>Chelonoidis denticulata</i> (Linnaeus, 1766)	No data (donor: Zoological Gardens, Kolkata, West Bengal) (1)	ZSI 16724
46	<i>Cylindraspis triserrata</i> (Günter, 1873)	No data (donor: Port Louis Museum, Mauritius) (1)	ZSI 14921
47	<i>Geochelone elegans</i> (Schoepff, 1795)	India: Visakhapatnam, Andhra Pradesh (4); Kolkata, West Bengal (erroneous locality) (1); nr. Pundal Village, 4 km w of Dak Bunglow, Bhilwara District, Rajasthan (1); forest nr. Udaipur, Rajasthan (1); 30 km Udaipur-Jodhpur Road, Rajasthan (1); Parvathsar District, Rajasthan (1); Palanpur, Banaskantha District, Gujarat (1); Sri Lanka: Sri Lanka (7)	ZSI 769, 774, 1145, 1147, 1148, 1149, 1152, 790, 791, 786, 15495, 792, 21694, 24529, 24530, 24519, 25041
48	<i>Geochelone platynota</i> (Blyth, 1863)	Myanmar: Myanmar (1), N Myanmar (3); Sittwe (1); N Bago (1)	ZSI 787, 788, 789, 988, 2653, 17049
49	<i>Indotestudo elongata</i> (Blyth, 1853)	India: Chaibasa, Singhbhum District, Jharkhand (1); Baradighi Tea Estate, Jalpaiguri, West Bengal (5); Bangladesh: West Bhanugach Reserve Forest, Moulvi Bazaar District (1); Myanmar: Myanmar (20); Sittwe (2)	ZSI 4, 1304, 1134, 1135, 1136, 1137, 18016, 18125, 713, 2652, 2653, 5, 8, 768, 52, 907, 908, 909, 989, 1101, 1116, 1117, 11379, 24753, 17992, 18162, 18016, 18125, 18171
50	<i>Indotestudo travancorica</i> (Boulenger, 1907)	India: Cochin State Forest, Kerala (2); Punalore, Travancore, Kerala (1)	ZSI 17697, 17017, 18045
51	<i>Manouria emys phayrei</i> (Blyth, 1853)	India: Cachar hills, Assam (2); Nongkhyllam Wildlife Sanctuary, Khasi Hills, Meghalaya (1); Myanmar: Rakhine (8); 'Madagascar' (erroneous locality) (1)	ZSI 813, 814, 15492, 730, 983, 984, 985, 3950, 15489, 15545, 20476, 25125
52	<i>Testudo graeca</i> Linnaeus, 1758	Palestine: Hun-Sb-Tin, nr. Lake Galille (3); "SE Arabia": Karmun (2)	ZSI 11346, 11347, 11348, 300, 301
53	<i>Testudo graeca ibera</i> Pallas (1814)	Iran: Karmun (2); Palestine: Aun-Sb-Tin nr. Galille (2); Unknown (donor: Berlin Museum) (1)	ZSI 300, 301, 519, 11346, 11347
54	<i>Testudo hermanni</i> Gmelin, 1789	Unknown (donor: Berlin Museum) (8)	ZSI 507, 508, 509, 510, 515, 516, 517, 518
55	<i>Testudo horsfieldii</i> Gray, 1844	Afghanistan: Afghanistan (2); Kabul (5); Pakistan: Balochistan (4), Khanai, Quetta District (1); Quetta (3)	ZSI 11420, 15538, 15541, 15551, 15552, 16479, 16480, 16478, 793, 3856, 5591, 5592, 5593, 5594, 5595
Family: Trionychidae			
56	<i>Amyda cartilaginea</i> (Boddaert, 1770)	Malaysia: Perak (1); Pulau Pinang (2); Myanmar: Ayeyarwadi River (1)	ZSI 2632, 13207, 765, 1094
57	<i>Chitra indica</i> (Gray, 1831)	Bangladesh: Khulna (1); Dhaka (1); India: Allahabad, Uttar Pradesh (4); Kolkata, West Bengal; (2); Baradighi Tea Estate, West Bengal (1)	ZSI 367, 368, 483, 506, 1113, 1776, 16753, 1053, 1760
58	<i>Dogania subplana</i> (Geoffroy Saint-Hillaire, 1809)	Indonesia: East coast of Sumatra (1); Myanmar: Myeik Archipelago (1)	ZS 661, 11589, 13468,

59	<i>Lissemys punctata</i> (Lacépède, 1788)	Bangladesh: Machkharia Depa, Ukhia, Cox's Bazar District (1); India: Nagpur, Maharashtra (1); Goa (2); River Mahanadi, Orissa (1); Hazaribagh, Jharkhand (4); Ranchi, Jharkhand (3); Chaibassa, Jharkhand (1); Manbhum, Jharkhand (1); Singbhum, Jharkhand (5); Chotanagpur, Jharkhand (2); River Mahanadi, Cuttack, Orissa (3); Paradip, Orissa (1); Konarak, District Puri, Orissa (1); Mahakhand, Orissa (1); Nandankanan, Cuttack District, Orissa (1); Cuttack, Orissa (4); Dhamara, Orissa (1); Gopkuda Island, Chilka Lake, Orissa (1); Cheera Bandh, 5 km W of Chandawa District, Chotanagpur, Bihar (1); River Ganga, Bhagatpur, Bihar (1); Madras Museum, Chennai, Tamil Nadu (1); Travancore, Kerala (2); Cannore District, Kerala (1); Samaville, N of Palaconda, Srikakulam District, Andhra Pradesh (1); nr. Purulia, Manbhum District, West Bengal (1); Kolkata, West Bengal (6); Hooghly River, West Bengal (8); (1); Baradighi Tea Estate, West Bengal (1); Palta, 24 Parganas, West Bengal (1); Bangalore, Karnataka (1); Canacona Town, Goa (1); Ana Sagar, Ajmer, Rajasthan (1); Devdyan Sambhar Lake, Jaipur District, Rajasthan (1); Kachchh, Gujarat (1); Rajkot, Gujarat (1); Bachan, District Kachchh, Gujarat (1); Gudkar Nabhoi Forest, Bhuj, District Kachchh, Gujarat (1); Bilaspur, Chhatisgarh (1); Varanasi, Uttar Pradesh (2); River Ganga in Uttar Pradesh (1); Teliamura, Tripura (1); Myanmar: Myanmar (2); Moulmein (2); Mansam, N. Shan State (1); Sittwe (2); Pakistan: Sindh (1); Jempur, Sindh (1); River Indus (1); Sri Lanka: Colombo (1)	ZSI 246, 247, 248, 249, 250, 251, 252, 253, 16694, 294, 405, 12568, 15990, 16765, 1774, 23486, 1686, 1694, 1688, 1692, 1693, 254, 257, 260, 261, 263, 264, 280, 1660, 1025, 16764, 16689, 21695, 16772, 16785, 16786, 23800, 23945, 22571, 22692, 22709, 22745, 15911, 16911, 17016, 17043, 17044, 21151, 21129, 21007, 22011, 266, 267, 268, 269, 21476, 21981, 25046, 25040, 214, 215, 239, 875, 876, 877, 216, 218, 230, 232, 233, 234, 235, 238, 23003, 24302, 242, 243, 3877, 3879, 17993, 23006, 22963, 24754, 24850
60	<i>Nilssonina gangetica</i> (Cuvier, 1825)	Bangladesh: Khulna (2); India: Kolkata, West Bengal (15); River Hooghly, West Bengal (2); Allahabad, Uttar Pradesh (8); River Ganga, Uttar Pradesh (2); Agra, Uttar Pradesh (3); River Mahanadi, Cuttack, Orissa (1); Cuttack, Orissa (3); River Hasdeo, Chattisgarh (2); Firozpur, Punjab (1); Sambalpur, Orissa (1); River Ganga at Bhagatpur, Bihar (1); River Chambal, Madhya Pradesh (1); Pallapeddygudum Village, Guntur, Andhra Pradesh (1); Rajmahal, Jharkhand (1); Bhopal, Madhya Pradesh (1) Pakistan: River Indus, Karachi (5)	ZSI 1716, 1720, 1722, 1724, 1080, 1083, 1084, 1085, 879, 1893, 1813, 1805, 1806, 1808, 3870, 756, 468, 317, 736, 3873, 284, 1729, 1810, 1053, 1054, 286, 3869, 3872, 1835, 1836, 1732, 1727, 1728, 17014, 287, 291, 16751, 16750, 16912, 17014, 17015, 1087, 1088, 17613, 16790, 23004, 24821, 21238, 16791, 23801
61	<i>Nilssonina hurum</i> (Gray, 1831)	Bangladesh: Kaligunj, Khulna (2); "Assam side of Sunderbans" (= Chittagong, Bangladesh) (1); Khulna, Bangladesh (1); Natore, Rajshahi (1); India: Kolkata, West Bengal (11); Uttarapara, West Bengal (1); Rajmahal, Jharkhand (1); "Gangetic Delta" (1); Nazeerah, Assam (1); Sibsagar, Assam (1); Sonarpur, Assam (1); Allahabad, Uttar Pradesh (3); Lower Lake, Bhopal District, Madhya Pradesh (1); Little Gandak River, Pusha, Bihar (1); Klierpur, Purnea District, Bihar (1); Oodhuna, Rajmahal, Jharkhand (1)	ZSI, 1796, 1784, 1047, 1050, 1810, 16505, 1090, 270, 271, 272, 276, 283, 303, 402, 497, 495, 1196, 20818, 16627, 16996, 16750, 16752, 24408, 17714, 18018, 660, 5578, 17007
62	<i>Nilssonina formosa</i> (Gray, 1869)	Myanmar: Myanmar (6); Mandalay (2); Ayeyarwadi River (3); Mawlamyine (1)	ZSI 277, 278, 687, 1051, 688, 1785, 634, 1837, 766, 1786



63	<i>Nilssonia leithii</i> (Gray, 1872)	India: Peddavagu River, nr. Payavaram village, Andhra Pradesh (1); River Godavari, Andhra Pradesh (1); Nallamalai, Eastern Ghats, Andhra Pradesh (1); River Mula nr. Sathi Biscuit Company, Poona, Maharashtra (1); Dhond, Poona District, Maharashtra (1); Jamuna Tank, Nagpur, Maharashtra (1); Satara, District Satara, Maharashtra (1); Hasdeo River at Bilaspur, Chattisgarh (2)	ZSI 21403, 21477, 21539, 17973, 522, 523, 1731, 22564, 17716
64	<i>Nilssonia nigricans</i> (Anderson, 1875)	Bangladesh: Chittagong Tank (2)	ZSI 1918, 1898
65	<i>Pelodiscus sinensis</i> (Wiegmann, 1834)	China: Shanghai (2); Taihu, Jiangsu Province, China (1); Japan: Hienoe Lake (2); Unknown: (exchange - British Museum) (1)	ZSI 279, 4693, 4694, 18034, 18035, 18036
66	<i>Pelochelys cantorii</i> (Gray, 1864)	Kolkata, West Bengal (1)	ZSI 20478

Table-2: List of type collections of turtles currently present in the ZSI, Kolkata, updated from Das *et al.*, 1998).

Sl. No.	Systematic List	Locality (ex.)	Reg. No	Remarks
Family: Bataguridae				
1	<i>Batagur iravodica</i> Anderson, '1878' 1879	'Pegu' (= Bago, S Myanmar) or 'Bhamô in Upper Myanmar' (in Kachin State, N Myanmar)	ZSI 743 (syntype)	Subjective synonym of <i>Batagur trivittata</i> (Duméril and Bibron, 1835)
2	<i>Batagur petersi</i> Anderson, '1878'	Purchased in a 'Calcutta bazaar', the type series originating from 'Huzurapur' (in Jessor District, Bangladesh)	ZSI 155 and 156 (syntypes),	Current status: <i>Morenia petersi</i> (Anderson, '1878' 1879)
3	<i>Chaibassia theobaldi</i> Anderson, '1878' 1879.	'Bishnath Plain' (= Biswanath Plains, Sonitpur District, Assam, NE India)	ZSI 188-189 (syntypes) from	Current status: Subjective synonym of <i>Melanochelys tricarinata</i> (Blyth, 1856)
4	<i>Cyclemys dhor shanensis</i> Annandale, 1918	'Fort Stedman on the Inlé Lake, altitude 3,000 feet' (in Shan State, N Myanmar); ZSI 18594 (syntype), from 'He-Ho plain 800 feet higher' (than 3,000 feet) (in Shan State, N Myanmar)	ZSI 18593 (syntype), ZSI 18594 (syntype),	<i>Cyclemys shanensis</i> Annandale, 1918
5	<i>Emys nuchalis</i> Blyth, 1863	'Java?' (= Jawa, Indonesia)	ZSI 824-826 (syntypes)	Subjective synonym of <i>Malayemys subtrijuga</i> (Schlegel and Müller, 1844)
6	<i>Emys (Pangshura) tectum</i> var. <i>intermedia</i> Blanford, 1870	'Chappa and Korba in Biláspúr, on the Hasdo river' (= River Hasdeo, in Chattisgarh, C India)	ZSI 122-123 (syntypes)	<i>Pangshura tentoria tentoria</i> (Gray, 1834)
7	<i>Emys trijuga</i> var. <i>Burnnana</i> Anderson in Theobald, '1878' 1879	'Bhamo' (in Kachin State, N Myanmar)	ZSI 830 (syntype)	Subjective synonym of <i>Melanochelys trijuga edeniana</i> (Anderson in Theobald, 1876)
8	<i>Emys trijuga</i> var. <i>coronata</i> Anderson, '1878' 1879	'Travancore' (in Kerala State, SW India)	ZSI 1012 (holotype)	Current status: <i>Melanochelys trijuga coronata</i> (Anderson, '1878' 1879).
9	<i>Emys trijuga</i> var. <i>madraspatana</i> Anderson, '1878' 1879	'Madras' (= Chennai, Tamil Nadu State, SE India)	ZSI 831, 1008 and 1009 (syntypes)	Subjective synonym of <i>Melanochelys trijuga trijuga</i> (Schweigger, 1814)
10	<i>Geoemyda depressa</i> Anderson, 1875	'Arakan' (= Rakhine Yoma, W Myanmar)	ZSI 751 (syntype)	Current status: <i>Heosemys depressa</i> (Anderson, 1875)
11	<i>Geoemyda indopeninsularis</i> Annandale, 1913	'Singhbhum district of Chota Nagpur' (in Jharkhand State, E India) and 'Dharwar district...southern part of the Bombay Presidency' (in error) (in Karnataka State, SW India)	ZSI 17098 and 17100 (syntypes)	Current status: <i>Melanochelys trijuga indopeninsularis</i> (Annandale, 1913)

12	<i>Geoemyda silvatica</i> Henderson, 1912	'Near Kavalai in the Cochin State Forest...at an elevation of about 1500 feet above sea level' (in Kerala State, SW India)	ZSI 17117 (holotype)	Current status: <i>Vijayachelys silvatica</i> (Henderson, 1912)
13	<i>Geoemyda trijuga</i> subsp. <i>plumbea</i> Annandale, 1915	'Coorg on the east side of the Western Ghats' (in Karnataka State, SW India)	ZSI 17712 and 17715 (syntypes)	Current status: Subjective synonym of <i>Melanochelys trijuga trijuga</i> (Schweigger, 1814)
14	<i>Geoemyda tricarinata</i> Blyth, '1855' 1856	'Central India (Chaibása)' (in Jharkhand State, E India)	ZSI 816 (holotype)	Current status: <i>Melanochelys tricarinata</i> (Blyth, '1855' 1856)
15	<i>Melanochelys edemiana</i> Anderson in Theobald, 1876	'Arakan, Pegu, and Tenasserim' (= Rakhine Yoma, Bago and Taninthayi, W and S Myanmar)	ZSI 1371, 1369, 1010, 1011, 1018, 1097 and 930 (syntypes)	Current status: <i>Melanochelys edemiana</i> Anderson in Theobald, 1876
Family: Testudinidae				
16	<i>Homopus Burnesii</i> Blyth, 1853	'Afghanistan'	ZSI 793 (holotype)	Current status: Subjective synonym of <i>Testudo horsfieldii</i> Gray, 1844.
17	<i>Testudo baluchiorum</i> Annandale, 1906	'Baluchistan' (= Balochistan Province, NW Pakistan)	ZSI 11420 (holotype)	Current status: Subjective synonym of <i>Testudo horsfieldii</i> Gray, 1844
18	<i>Testudo elongata</i> Blyth, 1853	'Arakan' (= Rakhine Yoma, W Myanmar)	ZSI 796, 798-800 (syntypes)	Current status: <i>Indotestudo elongata</i> (Blyth, 1853).
19	<i>Testudo megalopus</i> Blyth, 1853	Type locality not mentioned in the original description; specimen registered as collected from the streets of Calcutta (= Kolkata, West Bengal State, E India)	ZSI 792 (holotype)	Subjective synonym of <i>Geochelone elegans</i> (Schoepff, 1794).
20	<i>Testudo parallelus</i> Annandale, 1913	'Chaibassa (Singhbhum) district, Chota Nagpur' (in Jharkhand State, E India)	ZSI 11379 (holotype)	Subjective synonym of <i>Indotestudo elongata</i> (Blyth, 1853).
21	<i>Testudo Phayrei</i> Blyth, 1853	'Arakan; Tenasserim Provinces' (= Rakhine and Taninthayi, W and S Myanmar)	ZSI 813 and 15492 (syntypes)	Current status: <i>Manouria emys phayrei</i> (Blyth, 1853).
22	<i>Testudo platynotus</i> Blyth, 1863	'Lower Pegu' (S Bago, S Myanmar)	ZSI 787-89 (syntypes)	Current status: <i>Geochelone platynota</i> (Blyth, 1863)
Family: Trionychidae				
23	<i>Emyda granosa intermedia</i> Annandale, 1912	'Near Purulia, Manbhum Dist.' (in West Bengal State, E India)	ZSI 16764-65 (syntypes)	Subjective synonym of <i>Lissemys punctata punctata</i> (Bonnaterre, 1789)
24	<i>Trionyx Buchananii</i> Theobald, 1874	'Bengal' (then comprising Bangladesh, West Bengal State, E India, as well as parts of E Bihar)	ZSI 1090 (holotype)	Subjective synonym of <i>Nilssonina hurum</i> (Gray, 1831).
25	<i>Trionyx gangeticus mahanadicus</i> Annandale, 1912	'Cuttack' (in Orissa State, eastern India)	ZSI 17014 (holotype)	Subjective synonym of <i>Nilssonina gangetica</i> (Cuvier, 1824)
26	<i>Trionyx nigricans</i> Anderson, 1875.	'Chittagong, Bengal' (in SE Bangladesh)	ZSI 664 and 1898 (syntypes)	Current status: <i>Nilssonina nigricans</i> (Anderson, 1875).
27	<i>Trionyx sulcifrons</i> Annandale, 1915	'Nagpur...Central Province of India' (in E Maharashtra State)	ZSI 17973 (holotype)	Subjective synonym of <i>Nilssonina leithii</i> (Gray, 1872)

Plate 2



(A)



(B)



(C)



(D)



(E)



(F)

Early curators and collectors of the Asiatic Society of Bengal, Indian Museum and Zoological Survey of India. (A): Edward Blyth (1810–1873); (B): Ferdinand Stoliczka (1838–1874); (C): John Anderson (1833–1900); (D): Thomas Nelson Annandale (1876–1924) and

Representatives of turtle types in the Zoological Survey of India.

(E): *Testudo phayrei* (ZSI 814) (F): *Trionyx sulcifrons* (ZSI 17973).

Chapter 03

Endemic Turtles of India

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Nilssononia leithii, Gray, 1872

Taxonomy

Synonymy. – *Trionyx leithii* Gray, 1872, *Aspideretes leithii* Meylan, 1987, *Nilssononia leithii* Praschag *et al*, 2007.

Nilssononia leithii was first described by Gray, 1872 as *Trionyx leithii* based on specimens collected by Dr. Leithi from Poonah Maharashtra. Meylan (1987) studied phylogeny of softshell turtles, based on osteological characters divided the family Trionychidae into two subfamilies Cyclanorbininae and Trionychinae and placed *N. leithii* in tribe Aspideretini and proposed the new genus name *Aspideretes*, Hay (1904) which included *A. gangeticus*, *A. hurum*, *A. nigricans* and *A. leithii*. He also placed another closely related genus *Nilssononia*, Gray (1869) in the tribe Aspideretini. Praschag *et al* (2007) based on molecular phylogeny studies found a well supported clade containing *Aspideretes* with the above mentioned four species and *Nilssononia formosa*. Considering priority as senior synonym, genus *Aspideretes*, Hay (1904) was synonymised to *Nilssononia*, Gray (1869) (Praschag *et al.*, 2007).

Vernacular names

Tamil: Parisal amai (Locally made round boat made of split bamboo and buffalo hide), Seravi amai (Seravi= common teal, because the turtles have a webbed foot like the common teal), Thoni amai (boat turtle). Kannada: Pale poo (Pale = leaf spath of areca nut palm). Telugu: Nadi tabelu (river turtle).

Description

Adults. – *Nilssononia leithii* has a low carapace and is oval in shape (Plate 3.1 A). A preneural with one or two neurals separate the first pair of pleurals, eighth pair of pleurals meets at midline of carapace. Eight or nine neurals are present. Plastral callosities are large and are five in number. Triturating surfaces of maxilla flat with a prominent median groove. A patch of wart-like tubercles present on the anterior edge of carapace and along midline posterior to the bony portion of the shell. Disk dark olive-green above with lighter vermiculations (Plate 3.1 A). Head greenish with a more or less defined black longitudinal streak from between the eyes on to the nape and two or three oblique black streaks diverging from it on either side, another streak starting behind the eye (Plate 3.1 C). These markings may be broken up and not only portions of them present. The corner of the mouth has a yellow or reddish-orange spot and patches of dark reddish-grey are present on the hind part of the head (Plate 3.1 D). Plastron cream coloured (Plate 3.1 B). The outer surface of the limb is olive and the inner surface cream coloured. Snout longer than the diameter of the orbit. Post-orbital arch one-half to one-third the diameter of the orbit. Alveolar surfaces of mandible not raised at its inner margin, more or less flat at the symphysis, which is usually longer than the diameter of the orbit (Gray, 1872; Boulenger, 1890; Smith, 1931; Das, 1991).

A sexually dimorphic species with males having longer and thicker tail than females (Das, 1991). A pair of them measured with similar body size, the male with 442 mm SCL had a tail length of 118.4 mm and the female measuring 440 mm in SCL had a tail length of 64.6 mm (Deepak and Vasudevan, Unpubl). Males measured between 442-635 mm (n = 4) in straight carapace length (SCL) and females measured were 358-548 mm in SCL (n = 3). The Males weight ranged between 6.6 – 26 kg (n = 4) and females weighed ranged 4.4-14.5 kg (n = 3) (data compiled from Moll and Vijaya, 1986; Deepak and Vasudevan, Unpubl).

Hatchlings. – Hatchlings are more grey or greyish olive with yellow vermiculations and marked with four to six well defined ocelli which are black surrounded by red, with a black outer border. Head greenish with black streaks extends towards the side of the head and another that extends backwards from the eye. The corner of the

mouth has a yellow or reddish orange spot and patches of the same colour are present on the forehead (Plate 3.1 E).

Distribution

Endemic to peninsular India, *N. leithii* has been reported from major rivers from peninsular India (Plate 3.1 F); Cauvery and Vaigai from Tamil Nadu, Krishna and Godavari from Andhra Pradesh, Neethravathi from Karnataka, Chalakudy, Bharathapuzha and Chaliyar in Kerala, Purna in Maharashtra and Godavari in Orissa (Gray, 1872; Boulenger, 1890; Moll and Vijaya, 1986; Kalaarasan *et al.*, 1992; Thomas *et al.*, 1997; Kumar, 2004; Vasudevan *et al.*, 2006; Nameer *et al.*, 2007; Praschag, *et al.*, 2007; Deepak and Vasudevan, Unpubl; Whittaker *pers comm*). Juvenile specimens of *N. gangetica* from the river Ganges and Hadso, Mahanadhi was possibly misidentified by Annandale (1912 a and b) as *N. leithii* (Moll and Vijaya, 1986; Peter Praschag *pers comm*). Smith's (1931) assessment of its range as river Ganges was again following Annandale (1912 a and b). Annandale (1915) himself states that all records of *N. leithii* specimens are from the Peninsular India. The present distribution range of the species includes Purna (Maharashtra) as Northern and North-Western limit of the species; Balimela reservoir, Godavari in Orissa is the North-eastern distribution limit and Chalakudy River in Kerala is the southern most distribution of the species known so far (Plate 3.1 F).

Habitat and Ecology

Nilssonina leithii inhabits rivers and reservoirs (Boulenger, 1890; Annandale, 1915; Moll and Vijaya, 1986; Kalaarasan *et al.*, 1992; Thomas *et al.*, 1997; Kumar, 2004; Vasudevan *et al.*, 2006; Nameer *et al.*, 2007; Praschag, *et al.*, 2007; Deepak and Vasudevan, *pers obs*). They are reported from shallow waters with substrates varying from sand to granite boulders (Thomas *et al.*, 1997; Nameer *et al.*, 2007). They are reported to feed on fish, crabs, freshwater molluscs and mosquito larvae (Biswas and Acharjyo, 1984; Das, 1995; Deepak and Vasudevan, *pers obs*). Nesting occurs in mid-June and possibly also in January, eggs measuring 30-31mm are laid (Das, 1991).

Threats

In most of its range, the species is hunted and consumed (Kalaarasan *et al.*, 1992; Kumar, 2004). Kumar (2004) noted its supply to local markets and toddy shops in Kerala for '100 to '300 depending on the size. Distribution range reduced due to river alteration and other habitat impact (IUCN, 2008).

Captive Husbandry

Nandankanan Zoological Park, Cuttack had two individuals of *Nilssonina leithii* which lived for two years in fish diet (Biswas and Acharjyo, 1984) there are no reported breeding populations of the species existing in the country.

Conservation measures taken

Nilssonina leithii is listed as 'vulnerable' (A1c) in the IUCN red list (IUCN, 2008; Year assessed 2000). It is also listed in Appendix II of CITES the threat due to trade on the species requires further verification in India, it is protected under schedule IV of the Indian Wildlife (Protection) Act (1972).

Vijayachelys silvatica, Henderson, 1912

Taxonomy

Synonymy. – *Geoemyda silvatica* Henderson, 1912, *Heosemys silvatica* McDowell, 1964

Vijayachelys silvatica Praschag *et al.*, 2006.

Henderson in 1912 described the species based on two specimens collected from Chalakudy forest, Kerala and placed them under the genus *Geoemyda* Gray, 1834. In those days the genus *Geoemyda* included variety of semi terrestrial and or terrestrial turtles from Oriental and Neotropical regions. McDowell (1964) reorganized the Emydidae largely on the basis of cranial anatomy and partitioned the genus *Geoemyda* -into *Heosemys*, *Melanochelys*, *Rhinoclemmys* and *Geoemyda*. McDowell (1964) included *silvatica* in the genus *Heosemys*, Stejneger,

1902 without studying any forest cane turtles. Moll *et al* (1986) based on osteological characters compared *Geoemyda spengleri*, *Heosemys grandis* and *Heosemys spinosa* and proposed to transfer *H. silvatica* back to its original genus *Geoemyda*. However, this was not generally accepted, and some authors e. g. Ernst and Barbour (1989) and Ernst *et al* (2000), continued using the combination *H. silvatica*. Praschag *et al* (2006) based on phylogenetic distinctness proposed an all new Genus *Vijayachelys* (named in honour of the late Indian herpetologist Jaganath Vijaya) which includes only *Vijayachelys silvatica* (a monotypic genus).

Vernacular names

Tamil: Vengala amai (= brass turtle), Malayalam: Churrel amai (= cane turtle), Kannada: Bettadh/Bettada amae (= rock turtle), Thulu: Kunde amae (= small turtle) Kadar: Sengani amai (= plum turtle), Kanis: Ayani ilaiyan amai (Fallen leaf turtle), Sengkannan (= red-eyed turtle), Mootal amai (= roof turtle).

Description

Adults. – *Vijayachelys silvatica* has a low carapace with three prominent keels (Plate 3.2 C). The carapacial keels are prominent in all but the oldest individuals and the central one is the most pronounced. The carapace varies from cinnamon to tawny or raw umber in females with dark brown stripe along the central keel and males with much darker than females varying from burnt umber to dusky brown. Plastron varies from buff to buff yellow in females and are straw to sulfur yellow in males. Maxillae form a distinct median hook, labial ridge slightly serrated irregularly. Nuchal scute well developed. The forelimbs are heavily armoured anteriorly with enlarged, imbricate, squarish to pentagonal shaped scales extending into the toes and soles of feet. On hind limbs enlarged scales are confined to the posterior medial surface except for the feet where they cover the entire surface. A large pointed scale is present on each heel (Henderson, 1912; Smith, 1931; Moll *et al.*, 1986; Praschag *et al.*, 2006).

A sexually dichromatic species with males having darker and brighter pink markings on the head compared to females and the iris is usually flame scarlet surrounded a scarlet sclera (Plate 3.2 A). The mandible is yellow to orange yellow and considerably brighter than that of females. Typical head colouration of females ranges from clay to cinnamon rufous; some old females also have light brick red. The iris is amber to chrome orange and is surrounded by a scarlet to flame scarlet sclera (Plate 3.2 B). Females poses a dull geranium pink coloured post ocular stripe but are not present in some. The mandibles are a dull buff which may be washed with red. The plastron tends to be buff to buff yellow (Moll *et al.*, 1986). In addition to the striking colour differences they are also sexually dimorphic; the males have a concave plastron, which are flat in females. A second dimorphic feature is the tail which is more elongated and thicker at the base in males. The length of the tail proximal to the cloacal opening exceeds the portion distal to it. In case of females the proximal portion is shorter. The third dimorphic feature is that the females are longer than males in SCL (Moll *et al.*, 1986; Deepak and Vasudevan, Unpubl) Males measured between 100-126 mm (n=24) in straight carapace length (SCL) and females measured were 114-139mm in SCL (n=18). The Males weight ranged between – 125-230 g (n=16) and females weighed ranged 200-340 gm (n=10) (data compiled from Moll and Vijaya, 1986; Deepak and Vasudevan, Unpubl).

Hatchlings. – Hatchlings are chiefly light brown. The carapace varies from cinnamon to clay and except for a somewhat lighter stripe along the central keel, is unicoloured. Head and neck is similar to that of shell but with orange markings. The iris is clay coloured surrounded by an orange sclera and eyelid (Plate 3.2 C). The plastron varies from buff yellow to cream (Moll *et al.*, 1986).

Distribution

The cane turtle is endemic to Western Ghats (Plate 3.2 D). Recently they are sighted from many different localities: Chalakudy, Poyankutti, Kulathupuzha and Nadukani reserve forests; Peechi-Vazhanai, Neyyar, Peppara, Idukki and Aralam Wildlife Sanctuaries; Parambikulam Tiger Reserve in Kerala. Anamalai Tiger Reserve (formerly Indira Gandhi Wildlife Sanctuary) and Kodayar in Tamil Nadu. Mookambika Wildlife Sanctuary, Sharavathi, Kathlaekan, Agumbe and Neria forest divisions in Karnataka (Vijaya, 1982; Sharath,

1990; Das, 1995; Daniels, 2001; Easa and Ramachandran, 2004; Jose *et al.*, 2007; Jaffer Palot *pers comm.*; T. V. Ramachandran *pers comm.*; Gururaja *pers comm.*; S. Bhupathy *pers comm.*).

Habitat and ecology

Vijayachelys silvatica are found in evergreen and semi evergreen forests of Western Ghats (Vijaya, 1982; Moll *et al.*, 1986; Deepak and Vasudevan unpubl). Vijaya's observation on cane turtles non affinity towards water bodies (Moll *et al.*, 1986) were found to be true, even during the drier months of the year the turtles never went near streams (Deepak and Vasudevan unpubl). Vijaya reports that they found more cane turtles in areas with considerable undergrowth of herbaceous plants around one to two feet tall, they were either concealed beneath the plants or amidst the leaf litter (Moll *et al.*, 1986). In 620 tracking days between July and March 2009, six turtles attached with radio-transmitter (3 male and 3 females) were found 61% of the time burried under leaf litter, 14% under liana, roots or tree buttress or fallen log, 13% in the open, 6% walking or mating or feeding, 5% inside tree hole or termite hill burrow. They are omnivorous feeding on fruits, leaves, molluscs, beetles, earthworms and millipedes. They are active predators searching for prey under leaf litter and use vantage points (fallen logs) to scan for food. However they also feed on small fallen fruits (*Diospyros buxifolia*) (Moll *et al.*, 1986; Deepak *et al.*, 2009).

Activity. –Radio-tagged turtles were more active during rainy days (47%) compared to non rainy days (23%) (n = 1351 tracking days). Cane turtles seize their activity (aestivates/hibernates) under leaf litter during December to February which are winter months and March to Mid may which is summer. Female # 5 was recorded from under leaf litter in one single locality for 46 days from 24th December to 7th May, 2008. A total of 54.08 hours (males - 30.37; females - 23.65) the turtles were observed. Based on these an ethogram consisting of 7 states (alert, sleeping, walking, scanning, starring, feeding and inactive) and 10 events (Yawning, wiping face, blinking, nosing, stretching limbs, penetrating litter, biting, head jerk, climbing and adjusting head) were observed in *Vijayachelys silvatica* (Smart, 2008).

Home range. –Home range of this species based on 620 days of radio-tracking of six turtles was 5-9 ha. The minimum and maximum distances moved in a day were 0.5 m and 266 m respectively.

Diet. – *Vijayachelys silvatica* are omnivorous and reported to feed on fruits, leaves, molluscs, beetles and millipedes (Moll *et al.*, 1986; Deepak *et al.*, 2009). Thirteen fecal samples collected from eleven individuals were examined. All fecal samples contained at least one identifiable prey item. Based on the occurrence of different food material in the faeces, 85% had insects and plant matter; 77% had sand; 69% had mollusc remains; 38% had millipede remains and 15% had seeds. *Vijayachelys silvatica* were observed feeding on the endemic snail *Indrella ampula* on four different occasions. It was also observed feeding on earthworms and fallen fruits (*Diospyros buxifolia*) (Deepak *et al.*, 2009).

Courtship and nesting. –Mating occurs during the start of south west monsoon, during the month of July and August in the Anamalai hills (Deepak and Vasudevan, Unpubl obs..). Four observations were made on mounting and copulation, males usually extends their head out and eyes forward and looks at the female while mounting (Deepak and Vasudevan, Unpubl obs..). Aggressive interactions between male cane turtles was reported from captive individuals (Moll *et al.*, 1986) and in the wild (Deepak and Vasudevan, Unpubl obs..). One single captive observation of the cane turtle laying egg was during the month of December, the female was collected from Chalakudy, Kerala. Eggs were laid in a small depression on the ground covered with leaf litter (Moll *et al.*, 1986). The clutch size of two eggs measured 44 x 22.5 mm and 45 x 23.5 mm. A week old hatching was found in Kanyakumari during the month of December (Daniels, 2001)

Population status. – The cane turtle were considered rare (Henderson, 1912; Groombridge *et al.*, 1983; Anonymous, 1983). The species is so well camouflaged that their detection probability is low, which the early workers construed to be rare. Recent findings on the cane turtle unveils that they are common in the mid elevation

evergreen forest in Anamalai hill ranges. In the ongoing study thirty five individuals of cane turtles (23 males, 9 females and 3 juveniles) were found within 1 km² area in evergreen forests over a span of three years. These figures may easily misconstrue to large population size, however these populations have certain constraints like extent of rainforest in elevations below 800m and non flooding areas within these available habitats.

Threats.

Hunting of cane turtles using dogs by native people (Kadar tribe) for consumption is reported from Chalakudy, Kerala (Vijaya, 1982). Habitat fragmentation is a well-documented scenario in Western Ghats (Nair, 1991) which eventually fragments the turtle's population. There are 24 operational and 12 proposed hydroelectric projects to be implemented in the state of Kerala alone, which would severely impact the biodiversity of this region (Sreekumar and Balakrishnan, 1998; Nikhil Raj *et al.* pers. Comm.). Submerging large tracts of forest for Dams can be an immediate threat to the species and their habitat.

Captive husbandry

The centre for herpetology, madras crocodile bank trust had few captive individuals of this species. Some observations on this captive group were published in the past (Anonymous, 1983; Moll *et al.*, 1986).

Conservation Measures Taken

Vijayachelys silvatica is protected under Schedule I of Indian Wildlife (Protection) Act of 1972. IUCN 2008 Red List: Endangered B1+2c.

Indotestudo travancorica, Boulenger, 1907

Taxonomy

Synonymy.– *Testudo travancorica* Boulenger, 1907, *Testudo (Indotestudo) travancorica* Williams, 1952, *Geochelone (Indotestudo) travancorica* Loveridge and Williams, 1957, *Indotestudo travancorica* Bour, 1980, *Indotestudo forstenii* Hoogmoed and Crumly, 1984, *Indotestudo travancorica* Pritchard, 2000.

Indotestudo travancorica was described by Boulenger (1907) as *Testudo travancorica* based on specimens collected by Ferguson, who believed it to be common in the Travancore Hills of Kerala, southwestern India. Boulenger noted that it bore resemblance to both *Testudo elongata*, from the northern and eastern parts of the Indian subcontinent, and *T. forstenii* [sic] from Celebes (now Sulawesi, Indonesia) and the neighbouring Gilolo Island (now Halmahera Island, Maluku, Indonesia). Smith (1931) also considered *T. travancorica* as very closely allied to *T. elongata*. Lindholm (1929) first recognized *T. elongata* as a distinct species and assigned it to the subgenus *Indotestudo* (under *Testudo*). While he did not mention the placement of the other two valid names, Williams (1952) included *travancorica* and *forstenii* in this subgenus. Subsequently, Williams partitioned the all-encompassing tortoise genus *Testudo*, by placing three tortoise species in the subgenus *Indotestudo*, which in turn was placed under the genus *Geochelone* (Williams in Loveridge and Williams, 1957). Bour (1980) elevated *Indotestudo* to a distinct genus, this was supported by cladistic analyses by Crumly (1982, 1984). Pritchard (1979: 319) suspected that tortoises from India could have been introduced into Indonesia, giving rise to disjunctive populations. When Hoogmoed and Crumly (1984) examined specimens of the three species of *Indotestudo*, they were unable to distinguish *I. forstenii* from *I. travancorica*. And therefore, *I. travancorica* was merged with *I. forstenii*, with the latter species name taking priority. Since then, the species name *I. forstenii* is associated with many reports of *I. travancorica* (eg: Frazier, 1989; Das, 1991, 1995; Sharath, 1990; Bhupathy and Choudhury, 1995; Radhakrishnan, 1998). Pritchard (2000) after examining specimens of *Indotestudo* from different regions suggested that *I. travancorica* be resurrected as a separate species because it was morphologically distinct from *I. forstenii* and *I. elongata*. Phylogenetic evidence supported the recognition of three distinct species, and also revealed that *I. travancorica* was more closely related to *I. elongata* than to *I. forstenii* (Iverson, *et al.*, 2001).

Vernacular names

Tamil: Periya amai (big tortoise), Kal amai (stone tortoise), Kadas: Vengala amai (brass tortoise). Kannada: Betta aame (Forest tortoise), Gudde aame (hill tortoise), Kadu aame (Forest tortoise). Malayalam: Churrel aama (cane tortoise).

Description

Adults. – *Indotestudo travancorica* has an elongated shell, usually flattened at the vertebral region with margins that may be reverted and mildly serrated at the anterior and posterior ends. Carapace and plastron are brown to chocolate brown and may have black blotches; blotches on the vertebrals usually surrounded by a central brown blotch that might fade into the marginals (Plate 3.3 A). Head is cream or yellowish-brown with pinkish-red colouration around the orbital skin and nares. Iris dark brown; upper mandible slightly hooked and tricuspid. Large, uneven, imbricate scales cover anterior part of the forelimbs. Tail ends in claw-like spur (Boulenger, 1907; Das, 1991; Pritchard, 2000). Absence of the nuchal scute (or if present, wedge-shaped), and the interhumeral seam that is 1-1.4 times the length of the interpectoral seam, differentiate it from its congeners *I. elongata* and *I. forstenii* (Pritchard, 2000).

A sexually dimorphic species, the abdominal region of the plastron is concave in males and flat in females while the tail claw is longer and hooked in males, small and conical in females (Vijaya, 1983; Auffenberg, 1964b; Das, 1991). There is no significant size difference between the sexes (Ramesh, 2008a). Their straight carapace length ranges from 55 mm to 330 mm, and they weigh between 35 g to 4010 g (Sane and Sane, 1989; Appukuttan, 1991; Das, 1995; Bhupathy and Choudhury, 1995; Ramesh, 2008a; Deepak and Vasudevan, unpubl.).

Hatchlings. – Hatchlings are usually uniformly brown though in a few, carapace or plastron may be mottled with darker spots (Plate 3.3 B). The shell is rubbery to touch, especially the plastron. The carapace appears rounded and anterior, posterior marginals have sharp transparent edges. Age or size at sexual maturity is unknown, but a male having 160mm SCL had a distinctly concave plastron and hooked tail claw (Ramesh, 2008b) indicating probable size of male sexual maturity.

Distribution

Endemic to the Western Ghats of peninsular India, *I. travancorica* has been reported from Kerala, Tamil Nadu and Karnataka states from 100-1000m msl (Plate 3.3 C) (Boulenger, 1907; Smith, 1931; Vijaya, 1983; Das, 1991; Bhupathy and Choudhury, 1995).

Habitat and Ecology

Indotestudo travancorica are found in the evergreen, moist deciduous, bamboo forests and, rubber and teak plantations of the Western Ghats. They frequent marshlands, dry grass openings in the forest and rocky biotopes close to streams (Vijaya, 1983; Bhupathy and Choudhury, 1995; Ramesh, 2008b; Deepak and Vasudevan, unpubl.). While inactive they use leaf litter, ground level cavities in trees, rocks, fallen logs and occasionally, pangolin burrows for shelter (Vijaya, 1983; Bhupathy and Choudhury, 1995). In an ongoing study in the Anamalai Hills of the Western Ghats, out of the 50 individuals recorded, 24 were found near streams and grassy marshes, 15 in forest interiors and 11 in Lantana camara bushes and rocky microhabitats. In 410 tracking days between February and October 2008, three tortoises attached with radio-transmitter (2 male and 2 females) spent about 40% of the time inactive under leaf litter, 25% inside pangolin burrows and termite hills, 15% in Lantana camara-associated scrub, 6% under fallen logs and grass, 5% in rock cavities and bamboo thickets, 3% in the open and 2% in ground level tree hollows (data summarized from 711 tracking days between February 2008 and April 2009). *Indotestudo travancorica* is crepuscular (Vijaya, 1983) and 70% of 23 tortoises were encountered between 1700 and 1830 h (Ramesh, 2008b) in the Anamalai Hills. But in an ongoing radio-telemetry study in the same region, tortoises were found active even during midday.

Home range. – The estimated home range of the species based on 493 days of radio-tracking of four tortoises was 8-12 ha. The minimum and maximum distances moved in a day were 0.8 m and 485 m respectively. Four radio-tracked individuals on an average moved 440m (350-586) in 1 year.

Activity. – Radio-tagged tortoises spent nearly equal proportions in being active and inactive during rainy and non rainy days (n=493 tracking days). However, a few individuals paused their activity during the dry season (February – May) in the Anamalai hills, when they buried themselves under dry leaf litter or inside termite hill burrows. One individual (Male #12) spent 106 days inside termite hill burrow in which the minimum and maximum temperature were 17.9°C and 25.3°C respectively when external temperature were 13.7°C and 31.8°C.

Diet - Tortoises feed on mushrooms, tender bamboo shoots, fallen fruits of *Artocarpus* spp., *Dillenia pentagyna*, *Ficus virens* and leaves of herbaceous plants such as *Synedrella nodiflora*, *Desmodium repandum*, *Senecio scandens*, *Mimosa pudica* and *Veronica buabauumii* (Vijaya, 1983; Ramesh and Parthasarathy, 2006; Deepak and Vasudevan, unpubl. data), apart from animals such as frogs, insects and millipedes (Das, 1991, 1995). Faeces collected from twenty four tortoises contained at least one identifiable diet item. Ninety two percent had grass/bamboo blades, 92% other plant matter (leaves and stems), 83% insect remains, 63% sand, 42% seeds (*Grewia tilaefolia* and *Dillenia pentagyna*), 38% vertebrate remains (identified as skink scale, mammal hair and vertebral bone) and 13% mollusc, scorpion and crab remains. They also scavenged on carcasses of mammals such as sambar (*Cervus unicolor*)

Courtship and nesting- Courtship consists of the following stages: (i) sex recognition by olfaction (ii) immobilisation of the female by shell-ramming and (iii) mounting and copulation (Auffenberg, 1964b). Male combat, consisting of shell-ramming and biting, also occurs (Das, 1991; Ramesh, 2008a). In adult male tortoises the pink coloration around the eyes and nares intensifies during the breeding season (Auffenberg, 1964a). The breeding season of *I. travancorica* is from November to January (Auffenberg, 1964a). But there are reports of breeding in other months of the year; a gravid free-ranging female was found in October (Moll, 1989) and in February-March, in captivity (Das, 1991). Nesting has not been observed in-situ till date. In captivity, the species excavated small chambers near the roots of trees, shrubs for egg-laying, and the entire process took about 50 minutes. Eggs were 47x38 mm in dimension and weighed 41 g (Ramesh, 2007). In captivity, clutch size varied from 1-5 eggs but is often three (Vijaya, 1983; Sane and Sane, 1989; Das, 1991, Ramesh, 2007); eggs have also been found on the floor of the enclosure (Sane and Sane, 1989) or in leaf litter (Das, 1991) probably due to lack of a suitable nesting substrate. The incubation period varied from 141-149 days in captivity and a hatchling measured 55mm (SCL) and weighed 35 g (Sane and Sane, 1989; Das, 1995).

Predation- *I. travancorica* are occasionally consumed or gnawed by large carnivores. A large (280 mm SCL), intact shell of the species (carapace and plastron) from the Parambikulam Wildlife Sanctuary, Kerala, had a deep puncture on the costal and scratch marks on the scutes. Similarly another live tortoise (172 mm SCL) had extensive scratch marks and was devoid of a few marginals (Plate 3.3 D); this was probably caused by some large carnivore such as *Panthera tigris*, *P. pardus* or *Cuon alpinus* found in the area.

Population status. – *Indotestudo travancorica* was reported to be a common species in the forests of the Western Ghats (Boulenger, 1907; Henderson, 1912; Vijaya, 1982) but no population estimates are available. Bhupathy and Choudhury (1995), during their surveys found evidences of the tortoise (shell remains) in the tribal hamlets. Encounters of the species from active searches in forests ranged from 6.7 hours per tortoise in Parambikulam Wildlife Sanctuary (from 20 man-hours) and 8.0 hours per tortoise in Indira Gandhi and Peechi-Vazhani Wildlife Sanctuaries (from 16 man hours each). The species might be more abundant in relatively undisturbed habitats. For instance, in a survey conducted in 2002-2003, fifty seven tortoises were captured with a mean search effort of 3.4 hours per tortoise (Ramesh, 2008a). Intensive sampling in a large forested landscape carried out during 2006-2008 in the same area yielded one tortoise in 17.5 hours in monsoon (from 508 man hours), 22.3

hours in summer, winter and post-monsoon (from 401 man hours) suggesting poor detection of the species by the observers or sparse distribution, or both.

Threats

In most of its range, the species is hunted and consumed. Tribes of the Western Ghats such as the *Kadar*, *Malai Pandaram*, *Kani*, *Malasar* and *Malaimalasar* hunt them using dogs or by following their tracks (Vijaya, 1983; Frazier, 1989; Moll, 1989; Choudhury and Bhupathy, 1993; Deepak and Vasudevan, unpubl). Sometimes, tortoises are also reared as pets till they attain a size suitable for consumption. *Kani* tribals also use charred shell mixed with oil as a cure for external injuries and skin rashes (Bhupathy and Choudhury, 1995). So far this species has not been reported in trade (Choudhury and Bhupathy, 1993). However, subsistence hunting of the species could reduce in their population (Vijaya, 1983; Frazier, 1989; Moll, 1989; Bhupathy and Choudhury, 1995).

Habitat alteration and fragmentation of forest due to hydroelectric reservoirs is known from almost all areas where the tortoise occurs (Bhupathy and Choudhury, 1995). There are 24 operational and 12 proposed hydroelectric projects to be implemented in the state of Kerala alone, which would severely impact the biodiversity of this region (Sreekumar and Balakrishnan, 1998; Nikhil Raj *et al pers comm.*). These projects also bring in settlers, who in turn pose a threat to the species by disturbing the habitat and hunting them.

Conservation measures taken

Indotestudo travancorica is listed as 'vulnerable' (A1cd) in the IUCN red list (IUCN, 2008). though we do not have records of this species in trade, it is also listed in appendix ii of cites, probably because it was earlier considered synonymous with the commercially exploited *I. forstenii* (Jenkins, 1995). the threat due to trade on the species requires further verification.

In India, it is protected under Schedule IV of the Indian Wildlife (Protection) Act (1972). Currently, this species has been reported from 10 Wildlife Sanctuaries, one Tiger Reserve and 5 Reserve Forests in the Western Ghats (Bhupathy and Choudhury 1995). The Western Ghats is a global biodiversity hotspot (Mittermeier *et al.*, 2005) and the conservation of biological diversity has been a priority for the nation. As a result, 56 Protected Areas (PA) have been notified covering 10% of the entire biogeographic region. (Versus India's PA covers 4.71% of total land area). The high proportion of PA cover for the Western Ghats is a reflection of the national level policies towards strengthening of protection of regions with high biological diversity and endemism. There are currently 50 protected areas in the 'Western Ghats Mountains', province 5B (Rodgers and Panwar, 1988) covering an area of 13236.18 Km². These PAs are of great significance to Travancore tortoise populations. However, they ensure protection for only 16% of the entire biogeographic unit that has potential habitat for the species. The reserves in this province have a mean area of 224.5 Km² with 25% of them <100 km². These limitations expose several populations to exploitation and insularization of remnant habitats of the species.

Only one captive breeding population of *I. travancorica* exists in India, at the Centre for Herpetology, Madras Crocodile Bank (Andrews and Whitaker, 1993; Choudhury and Bhupathy, 1993).

Captive Husbandry

The Centre for Herpetology, Madras Crocodile Bank Trust has the only captive breeding group of this species in the country. The group currently consists of four males, 14 females, and six juveniles which are housed in enclosures (Nikhil Whitaker, pers.comm.). Some observations on this captive group have been published over the years (Vijaya, 1983; Das, 1991, Ramesh, 2007).

Discussion

Current Research. – It is expected that the ongoing research project on the ecology of two endemic turtles in the Anamalai Hills by Wildlife Institute of India will provide the much needed information on the ecology of

Vijayachelys silvatica and *Indotestudo travancorica* from the wild. Studies on the captive Travancore tortoises at the Centre for Herpetology, Madras Crocodile Bank Trust would provide further insights on husbandry and developmental biology of the species. There are no ongoing studies on *Nilssonia leithii*, all information available on the species is based on some locality records and captive specimens. A survey documenting the distribution and status of these three species is currently in progress. Fact sheets for these species have been prepared and enclosed with this article for use by researchers and field managers (Plates 3.4-3.6).

Conservation measures proposed. – Conducting awareness campaign for the native people who consume turtles. Ensuring their population in protected areas by removing dogs from protected areas will be critical for the survival of cane turtle and Travancore tortoise. Regulate fishing during dry periods, when *Nilssonia leithii* is exposed and easy to hunt. Conducting awareness campaign for forest department officials.

Documentation. –Distributions of all the three species are based on compilation from literature. In the wake of rapid fragmentation in Western Ghats there is a need to document *Vijayachelys silvatica* and *Indotestudo travancorica* distribution along Western Ghats. Water pollution, damming rivers, channelization and sand mining are known to affect river turtle populations (Moll and Moll, 2004). *Nilssonia leithii* faces these threats in their known range, so there is a need to document their distribution and study their ecology.

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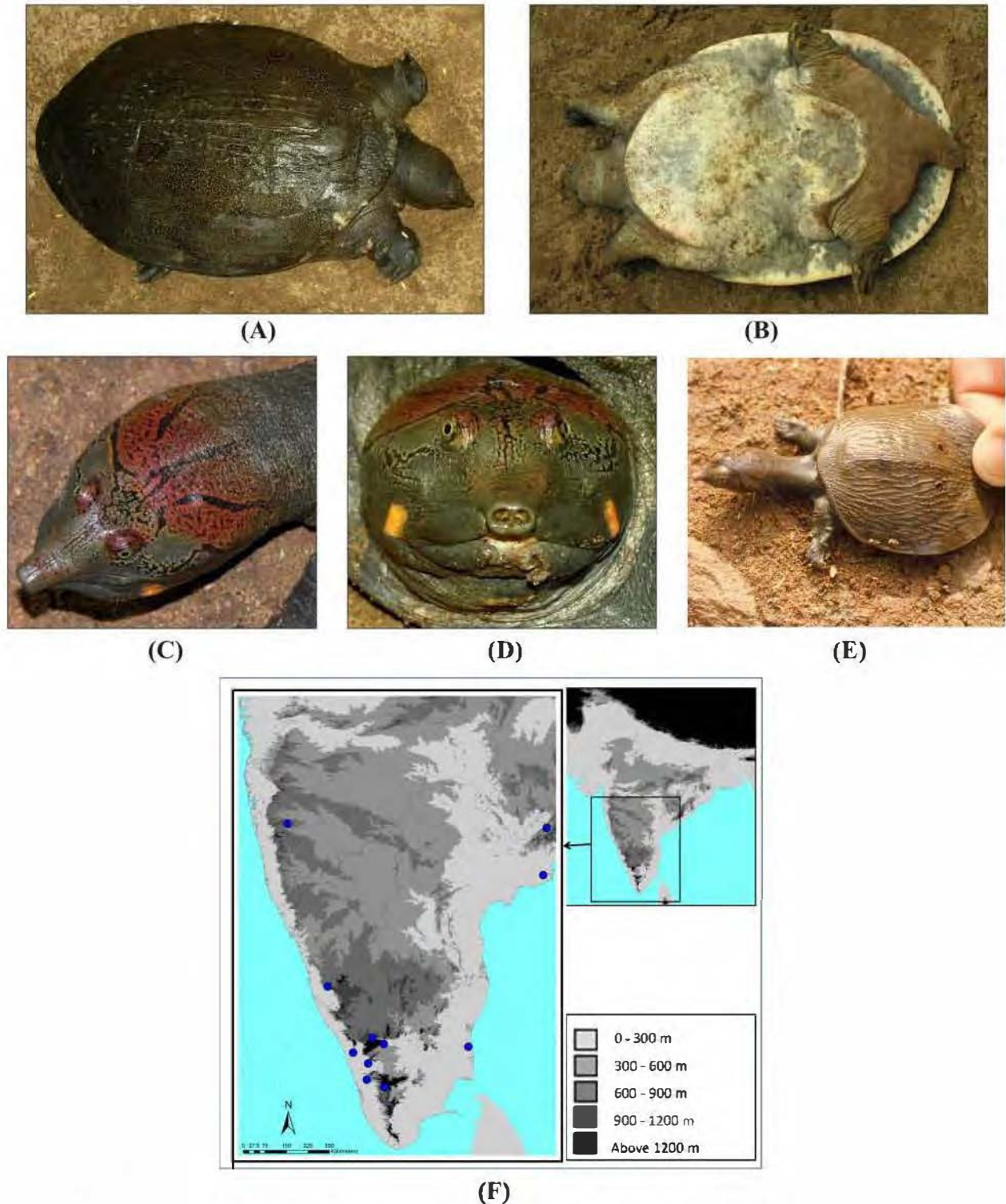
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Plate 3.1



Nilssononia leithii; (A): Carapace with prominent longitudinal streaks; (B): Ventral view showing narrow plastron; (C): Head showing orange spot on the corner of the upper lip; (D): Note-the damaged left lower jaw in the female seized after having been captured using fish hook. Photos (A-D) by V. Deepak; (E): Juvenile showing prominent ocellate markings on the back and less prominent head markings. Photo (E) by K. Vasudevan and (F): Distribution of *Nilssononia leithii* in peninsular India based on literature records.

Plate 3.2



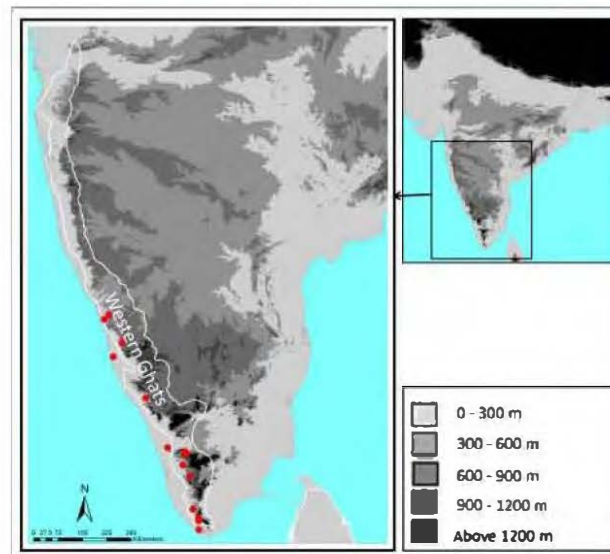
(A)



(B)



(C)



(D)

Vijayachelys silvatica; Closeup of head of (A) male and (B) female showing marked difference in eye colour, lower jaw and head colour. Note: Individual males have different colour pattern with combination of bright red, yellow and black; Individual females have different colour patterns but less prominent compared to males; (C): Juvenile female of *Vijayachelys silvatica* without bright colours on the head Photos (A-C) by V. Deepak and (D): Distribution of *Vijayachelys silvatica* in Western Ghats. Note most of the localities fall in the western slopes of Western Ghats in the low and mid elevations (5-900 m ASL)

Plate 3.3



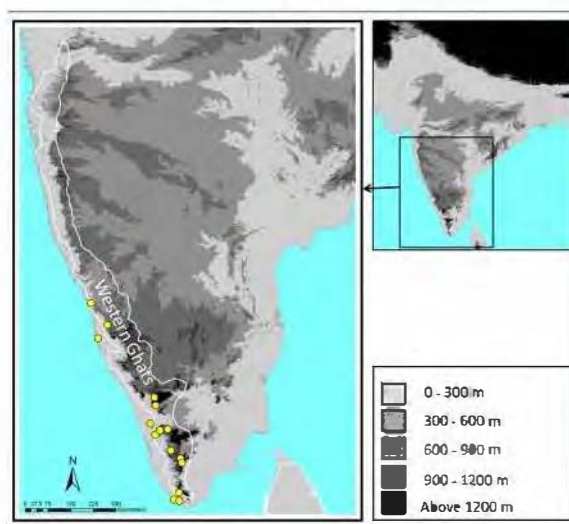
(A)



(B)



(C)



(D)

Indotestudo travancorica; (A) Female (B) Hatchling from the Anamalai Hills, Southern Western Ghats; (C): Hind part of plastron and carapace of *I. travancorica* showing scratch marks by carnivore. Photos (A-C) by V. Deepak and (D): Map of peninsular India with shaded region in grey indicating mountains of the Western Ghats, and the areas shaded in black indicating PAs. The PAs in the states of Kerala, Karnataka and Tamilnadu have populations of Travancore tortoise.

Plate 3.4

இந்தியாவில் மட்டும் காணப்படும் ஆமைகள்

ഇന്ത്യയിൽ മാത്രം ജീവിക്കുന്ന മകൾ

ಭಾರತಕ್ಕೆ ಸೀಮಿತವಾದ ಆಮೆಗಳು

India's Endemic Turtles

Locality records



உள் தொலைவை (Leith's softshell) ஒரு வெரிய நீர் ஆமை. அது நதிகளிலும், வெரிய நீர்நீர்வெள்ளங்களிலும் காணப்படும். அவை 330 மி. நீர் வலு வளரக்கூடியது. வாய் ஆமை. பீன்கள், நுண்நுண், கொக புழுக்கள் மற்றும் நீர் வாய் நந்தைகளை உணவாக உட்கொள்ளும். அவை ஈன் மீத மத்தியில் அருகாகக் குடும். மொத்த உடையின் எண்ணிக்கை தெரியாது. முட்டைகள் 30-31 மி. நீர் நன்ற வலு இருக்கும். குட்டிகளின் முதுகிலிருந்து தொலை 46 கன் கொண்டு வடிவங்கள் காண்பட்டும், வெரிய ஆமைகளின் மேல் உட்குழன் பின்புறம் ஆரதிக் நிற ஆமை வடிவம் இருக்கும். இந்த ஆமை காணப் படுகும் இடங்களிலெல்லாம் இவை அதிகமாகத் தொட்டைபடி உணவாக உட்கொள்ளப்படுகின்றன. இந்திரா மலைப் பகுதிகளும், தந்தினை மாநதி அமைப்பதற்கும் நிம்பகை ஆமை இனம் அபிதம் உயர்த்திக் கொள்ளுது. இவை கண்நிறம்: முதுகிலிருந்து உயரம் குறைகிறது. இவை கண்நிறம்: முதுகிலிருந்து உயரம் குறைகிறது. தொலைக் முகங்கூறும் நிம்பகை ஆமைகள் இருக்கும். தகுதி: உயரிலின் (UCN) டிரட் லின்ட் - கன்யாபுரி பரிசீலித வகையிலிருந்து (மாதுகையிலுடன் - கன்யாபுரி). பரிசீலித தகுதிடும், கொண்டு, கர்வாபும் மற்றும் அந்திரா மாநிலங்களில் உள்ள முக்கிய நதிகளில் இவை காணப்படும் மற்றும் ஒரின் மாநிலத்திலும், மணலாபுரம் மாநிலத்திலும் உள்ள சில நதிகளிலும் இவை காணப்படும்.

தகவல் கொடுக்க : தமிழ் : பரிசு ஆணை, சிறு
ஆணை, தேசிய ஆணை, கண்டம் : பாடுபு, தென்குடி :
நதிதமிழ்

இருவின ஆழமைய உங்கள் மதறியில் பார்த்தாலே,
கேள்வியிட்டாலே தயவு செய்து கீழ்க்கண்ட
முனவரிக்கு தெரிவிக்கவும். நாங்கள் கண்டிப்பாக
உங்களைத் தொப்புக்கொள்ளோம்.

ಸ್ವಲ್ಪ ಸಾಫ್ಟ್‌ಶೆಲ್ (Leith's softshell) ಎಂಬುದು ಹಿಪ್ಪೆಗಾಳಿ ಅಂರದ ನದಿ ಮತ್ತು ಕೆರೆಗಳಲ್ಲಿ ವ್ಯಾಪಿಸುವ ಕೀಟ. ಇದು 630 ಮಿಮೀ. ವರೆಗೂ ದೇಹದ್ದುಳ್ಳದ್ದು. ಇದು ಗಂಟುಗಳಿಂದಾಗಿ ಜಲಚರ. ಜ್ವಾಲಕಿ, ಇದು ಮೀನು, ವರಿ, ಮೊದಲನೆಯ ಮುಂ (ಸೋಲಿಯಂ ಶಾಸನ) ಮತ್ತು ಹಿಪ್ಪೆಗಾಳಿನಲ್ಲಿಯ ಮುದ್ದುಗಳಿಂದಾಗಿ ನದಿ ಬದಿ ಕಾಣುತ್ತದೆ. ಈ ಕೀಟವು ಮೂಲ ಕೀಟಗಳ ಮಧ್ಯದಲ್ಲಿ ಗೂಢವಾಗಿ ಕುಳಿವುದು. ಇವುಗಳೂ ಇವು ಮೊಟ್ಟೆ ಇಡುತ್ತವೆ ಎಂಬುದು ಹೆಚ್ಚು ತಿಳಿದಿದೆ. ಇವುಗಳ ಮೊಟ್ಟೆಗಳು 30-31 ಮುಚ್ಚಿರುವುದಕ್ಕೆ. ಮೊದಲು 4-6 ಪ್ರಕಾರವಾದ 'ಆಲ್ಬಿ' (ದೇರೆ ಬಣ್ಣದಿಂದ ಕಲ್ಪಿಸಲ್ಪಟ್ಟವು) ಒಂದು ಬಣ್ಣದ ಕೆಲವನ್ನು, ಆಳುಗಳ ಮೇಲೆ 3 ನ ಮೇಲೆ ಹೊಂದಿದೆ. ಮುಂದೆ ಕಮೀಗ್ ಮೇಲಿನ ಮದ್ದಿನಿಂದ ಮೇಲೆ ಒಂದು ಉಪವಿ ಕತ್ತರಿಸಿ ಬಣ್ಣದ ಗುರುತು ಕೊಡು. ಇದು ಮೂಲಕವಾದ ಎಲ್ಲಾ ಪ್ರಕಾರಗಳಲ್ಲಿಯೂ ಅಂತರಾಷ್ಟ್ರೀಯ ಅಂತರರಾಷ್ಟ್ರೀಯ ದೇಶ, ನದಿಗಳ ಮೇಲೆ ಇರುವ ನದಿಯ ವಲಸೆಯಿಂದ ಇವುಗಳೂ ಈ ಪ್ರಕಾರವನ್ನು ಕನಸುಮಾ ಆಳುಗಳ ಗುಡಿದೆ.

ಗುಣಿತವಿವಿಧ : ಇದು ಸ್ವಲ್ಪ ತಗ್ಗರ (low) ಮೇಲ್ಮೆ, ಚಿವುಟು, ಹೊಂದಿದೆ. ಇದರ ಕಲೆಯ ಮುಂಭಾಗದಲ್ಲಿರುವ ಮೂಲಿನ ಹೊಳೆಗಳು ಎಷ್ಟು ಕಾಣುತ್ತವೆ, ಚಿನ್ನ ಮುಂಭಾಗದಲ್ಲಿ ಸ್ವಲ್ಪ ಸ್ವಲ್ಪ ಗುರುಗಳು ಮೂಲಿತವೆ.

ಸ್ಥಾನಮಾನ : (IUCN) ಹಿಂದು ಮೃದುವು ಪ್ರಕಾರ 'ವಲ್ನರಬಲ್' (Vulnerable) ಎಂಬ ಗುರುತಿಸಲ್ಪಟ್ಟಿದೆ.

ರಾತ್ರರ ವಸ್ತ್ರವಿ (ಸಂರಕ್ಷಣೆ) ಕಾಯಿದೆಯ ಪ್ರಕಾರ ಇದು ಕೆಡ್ಡೂ IV ರಲ್ಲಿರುವ ಪ್ರಾಣಿ.
ಹಂಪಿ : ರಾತ್ರರ ವರ್ಯಾಯ ದ್ವೀಪ ಭಾಗಕ್ಕೆ ಮುಕ್ತ ಅನುಮತಿಯಿದೆ. ಅಂತ್ಯಪ್ರಣಿ. ಕೆರೆ, ಕರ್ನಾಟಕ ಮತ್ತು ತಮಿಳುನಾಡು ರಾಜ್ಯಗಳ ಮುಖ್ಯವಾರ ಸರ್ಕಾರಿ ಹಾಗೂ ಮಹಾರಾಷ್ಟ್ರ ಮತ್ತು ದೊಡ್ಡ ರಾಜ್ಯ ಸರ್ಕಾರಿ ಕಾರ್ಯಾಗಾರ. ಸ್ವರೂಪ ಹೆಸರುಗಳು: ಕೆನ್ನೆ : ಕೆನ್ನೆ ಕೆನ್ನೆ ತಮಿಳು : ಪರಿಶಿಲ್ತ ಅಮ್ಮ, ಕೆನ್ನೆ ಅಮ್ಮ, ಕೆನ್ನೆ ಅಮ್ಮ, ಕೆನ್ನೆ : ಸನ್ನಿ ಕೆನ್ನೆ.

ಈ ನಮೂನೆ ಇರುವಿಕೆಯ ಬಗ್ಗೆ ಮಾಹಿತಿ ದೊರಕದ ಕಥನವು ಈ ಪಾಠ್ಯವನ್ನು ನೋಡಿದರೆ ರಮ್ಯವು. ಈ ಕೆಳಗೆ ಕೊಟ್ಟಿರುವ ವಿವರಣೆ ಪ್ರಕೃತಿ ಬರೆಯುವ ಮೂಲಕ ಜೀವಾತ್ಮದ ದೇವತೆಯ ಮೂಲಕ ವಿವರಿಸುವ, ತಿಳಿದಿರುವ ನಾವು ಮದ್ಯಗಿ ಮಾಹಿತಿ ಪಡೆಯುವ ಸಂಪರ್ಕವಿರುವುದು.

ലിത്തിയുടെ വെള്ളാമ (Leith's softshell)

[illegible]

திருப்புகழ் - புகழை அளிக்கும் பெரிய தோஷம், தவறுகள்
 ஆகியவற்றை; இது காங்கிரஸ் மக்கள், அமைதிப் படைகள்
 உருவாக்கிவிட்டிருக்கும் துரோகத்திற்கு எதிராகப் புரட்சி செய்து,
 இவ்வகை செய்திகள் திருப்புகழைப் புகழுவதற்கு.

[illegible]

Leith's softshell (*Nilssonia leithii*) is a large fresh water turtle found in rivers and reservoirs. It grows up to 630 mm and is completely aquatic. It feeds on fishes, crabs, mosquito larvae and fresh water molluscs. It nests during mid June, clutch size is unknown. The eggs measure 30-31 mm. Hatchlings have 4-6 prominent ocelli on the carapace. Adults have a prominent orange marking on the upper jaw. In most of its range, the species is hunted and consumed. It is threatened due to river alteration and pollution. Identification: It has a low carapace. Nostrils in front of the head are prominent and the front of shell has many wart like projections. Status: IUCN Red list - Vulnerable; India's Wildlife (Protection) Act- Schedule IV. Distribution: Known only from Peninsular India, Major Rivers in the state of Andhra Pradesh, Kerala, Karnataka and Tamil Nadu; and in some rivers of Maharashtra and Orissa. Vernacular names: Tamil: Parisal amal, Seravi amal, Thoni amal. Kannada: Pale poo. Telugu: Nadi tabelu.

If you have seen or heard about this tortoise anywhere in your area, please write or contact us at the address given below and we will get in touch with you soon

Contact: Karthikeyan Vasudevan, Wildlife Institute of India, P.O. Box 18, Chandrabani, Dehradun 248001, Uttarakhand, India
Phone: 0135-2640111 to 115; email: turtle&tortoise@wii.gov.in
Photos and map: V. Deepak

Locality records

[illegible]

If you have seen or heard about this tortoise anywhere in your area, please write or contact us at the address given below and we will get in touch with you

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Plate 3.6

இந்தியாவில் மட்டும் காணப்படும் ஆமைகள்

ഇന്ത്യയിൽ മാത്രം ജീവിക്കുന്ന മകൾ

ಭಾರತಕ್ಕೆ ಸೀಮಿತವಾದ ಆಮೆಗಳು

India's Endemic Turtles

Locality records



திருவாங்கன் ஆமை (Travancore tortoise) ஒரு பெரிய கட்டு ஆமை. ஆறு 330 மி.மீ வரை வளரக் கூடியது. அது அதிக எலவியை மறைக்காடுகளில் 450-850 மீ தகில் மட்ட உயரத்தில் காணப்படும். ஆண் ஆமைகள் இயற்கையோடுகையில் மோது வற்றோடு வற்ற மோதிகளெனும். பெண் ஆமைகள் மணல்களில் ஒரு சிறிய புதிதோன்ற அடிகள் மறைப்பும், வற்ற முதல் ஐந்து முட்டைகள் வரை இடுகும். ஆமைகுஞ்சுகள் 55-60 மி.மீ நீளம் வரை இருக்கும். இவ்வகை ஆமைகள் அறிதகளில் வேட்டையாடப்படுகின்றன. ஆறு மட்டும்தான் காட்டுநீர், வாழிடம் தரக்கேடு மற்றும் வாழும் துண்டிப்பதில் லுமகை இவ்வகை அறியும் அறியும்துண்டிப்பதில் உளளது.

தினம் ஊட்டிதம்: தனவயின் நின் முதுகோட்டல்
சிறிய செதில் இருக்காது ட்டுன் முதுகெனும்பு
பாகத்தில் இரண்டாவதாக வரும் ஓடுதான்
ஆனவயின் உயரமான பருதி ஆகும்.

தகுதி : ஐ.யு.சி.என் (IUCN) டெட் லிஸ்ட் -
வழங்காயல், இந்திய வனவிலங்கு (மாதிரி)
சட்டம், செப்டம்பர் IV.

பரவியிருத்தல் : தமிழகம். கேரளம் மற்றும்
கர்நாடகா மாநிலங்களில் மேற்கு தொடர்ச்சி
மலைப்பகுதியில் மட்டும் காணப்படுகிறது.

அவரவர் மொழிகள் : தமிழ் : பெரிய ஆமை. கல் ஆமை, காபி : வெங்கல ஆமை, கள்ளம் : பெட்ட ஆமை, சூட்டை ஆமை, காடு ஆமை. மனையாளம் : சூர் ஆமை.

இவ்வின ஆமையை உங்கள் பகுதியில்
பாந்தாலோ, கேள்விப்பட்டாலோ நயவு செய்து
கீழ்க்கண்ட முகவரிக்கு தெரிவிக்கவும். நாங்கள்
கண்டிப்பாக உங்களை தொடர்புக்கொள்வோம்.

ಟ್ರಾವಂಕೋರ್ ಅಮ್ಮೆ (Travancore tortoise): ಕಾಡಿನಲ್ಲಿ ಬಹಳವಿರುವ ಒಂದು ಅರಿದೊಡ್ಡ ಹಾವು. ಇದು 310 ಮಿಮೀ ಸಾಧ್ಯವಿರುವುದು. ಇದು ಮುಖ್ಯವಾಗಿ ಹುಣ್ಣು ಮತ್ತು ಕಡಲೆಗಳಲ್ಲಿ ವಾಸಿಸುತ್ತದೆ. ಇದು ದ್ವಿಗುಣಿಗಳು, ಕೀಟಗಳು, ಸಣ್ಣ ಹಿಡಿಯುವುದರ ಪ್ರಾಣಿಗಳು, ಕಿರಿಕರಗಳು ಮತ್ತು ಹಣ್ಣುಗಳನ್ನೂ ತಿನ್ನುತ್ತದೆ. ಇದು 450-550 ಎಂ. ಸಮುದ್ರಮಟ್ಟದಿಂದ 900ಮೀಟರ್‌ಗಳ ಮಟ್ಟಕ್ಕೆ ಕಾಡುಗಳಲ್ಲಿ ಕಂಡು ಬರುತ್ತದೆ. ಸಂರಕ್ಷಣಾತ್ಮಕವಾಗಿ ಸಮುದ್ರದಲ್ಲಿ ಕಂಡು ನವೆಂಬರ್‌ನಿಂದ ಮಾರ್ಚ್‌ನಲ್ಲಿ ಗಂಡು ಹೆಣ್ಣುಗಳು ತಮ್ಮ ಹೊರ ಮೇಲ್ಮೈ ಸ್ನಾಯವ ರಸದಿ ಮೂಡುತ್ತವೆ. ಇವುಗಳು ನೇರದಲ್ಲಿ ಸ್ನಾಯವರ ಗುಂಡಿಗಳು ಮೂಡಿಕೊಂಡು ಕ್ರಿಶ 50-60 ಮಿಮೀ. ಗಾತ್ರದ ಮೇಲ್ಮೈಗಳನ್ನು ಹೊತ್ತುತ್ತದೆ. ಇದನ್ನು ಬೇಟೆಯಾಡುತ್ತಾರೆ. ಹಾಗೂ ಕಳ್ಳವಸ್ತು, ಅಪಾಕಸ್ನಾನದ ಸೌಕರ್ಯ ಮತ್ತು ಅಪಾಕಸ್ನಾನದ ಕಠಿಣಗಳಿಂದಾಗಿ ಈ ಪ್ರಾಣಿಯ ಅಪನಾಶವು ಹೆಚ್ಚು ತಡೆದುಬಿಡು ಹೋಗಿದೆ.

ಗುರುಕವಿತೆ : ಈ ಆಮೆಯಲ್ಲಿ ನೆಕ್ಕಿಯ (ತಲೆ) ಮೇಲಿನ
ಝಳ್, ಇರುವುದಿಲ್ಲ ಮತ್ತು ಬೆನ್ನುಹುರಿಯ ಜೊತೆ ಇರುವ
ಎರಡನೇ ಝಳ್ ಮೇಲ್ಮೈಪ್ರಜ್ಞೆ ಹಿರಿಯಲ್ಲಿರುತ್ತದೆ.

ಸ್ಥಾನಮಾನ : IUCN ಕೆಂಪು ಪಟ್ಟಿಯ ಶ್ರುತರ ಇದು 'ವಲ್ನರಬಲ್' (Vulnerable) ಎಂದು ಗುರುತಿಸಲ್ಪಟ್ಟಿದೆ. ಭಾರತದ ವನ್ಯಜೀವಿ ಸಂರಕ್ಷಣಾ ಕಾಯಿದೆಯ ಪ್ರಕಾರ ಇದು ಕಡು ಬಗಿ ರಕ್ಷಿಸುವ ಪ್ರಾಣಿ.

ಪರಿಚಿತ: ಈ ಆಮೆಗಳು ಕೇರಳ, ಕರ್ನಾಟಕ ಹಾಗೂ ತಮಿಳುನಾಡು ರಾಜ್ಯಗಳಲ್ಲಿರುವ ಪಶ್ಚಿಮ ಘಟ್ಟದ ಕಾಡುಗಳಲ್ಲಿ ಸಾಮಾನ್ಯವಾಗಿರುತ್ತವೆ.

ಸ್ವರ್ಗಯ್ಯ ಹೆಸರುಗಳು : ಕನ್ನಡ - ಬೆಳ್ಳಿ ಅವಿ. ಗುಡ್ಡ ಕವಿ. ಕಾಡು ಅವಿ. ಮಂಜುಳಾಂ - ಚುಕ್ಕರ ಕವಿ. ಕುಮಾರಿ ಸರಿಯ ಅವ್ವ. ಕೆರೆ ಅವ್ವ. ಕಡಾಪ - ಮಂಗಲ ಅವ್ವ. ಆ ಕುಲಯ್ಯನು ನೋಡಿದರೆ ಆಕಾಶ ಅದು ಮನುಷ್ಯನಿಗೆ ನಿಮ್ಮ ಸ್ವರ್ಗದಲ್ಲಿ ಮಾಹಿತಿ ದೊರಕರೆ. ದಯವಿಟ್ಟು ಈ ಕೆಳಗೆ ಕೊಟ್ಟಿರುವ ವಿಳಾಸಕ್ಕೆ ಬರಲು ಆಕಾಶ ದೊರಕುವುದೆಂದು ಮೊದಲೇ ಹೇಳಿದ್ದು ತಿಳಿಸಿ. ನಂತರ ನಾನು ನಮ್ಮದೊಳಗೆ ಇದರ ಬಗ್ಗೆ ಮಾಹಿತಿ ಪಡೆಯಲು ಒಂದುವೇಳೆ ಕೂಡುವುದೆನಿಸಿತು.

തിരൂവനാംകുരികൾ (Travancore tortoise) 330
 മില്ലി മുറ്റംനാളം വലുപ്പമുള്ള കാടാമകളാണ്.
 തിരൂവനാംകുരികൾ കേരളം, താമരക്കുളം, പാമ്പാലൂർ,
 കുന്നൂർകുളം, പഴശ്ശി തുടങ്ങിയവിനോളം എല്ലാ-
 ഭാഗങ്ങളിലുമുണ്ടായിരുന്നു. ഇവയുടെ പ്രധാനതാഹാരം,
 കുതിച്ചുപിടിക്കുന്ന, പച്ചകുളിമാമ്പൻ, 450 മുതൽ 650
 മില്ലി വരെ ഉയരമുള്ള മലമ്പ്രദേശങ്ങളിലാണ്
 ഉണ്ടായ സ്ഥലമാണായിരിക്കുന്നത്.

[illegible]

നിവിച്ചറിയാൻ: തവിട്ട് നിറത്തിലുള്ള പുറംതോടിൽ കുറുപ്പോ, കട്ടും കാപ്പിനിറത്തോടു കൂടിയതോയെ ചെവിയിൽ വെറുലോക്കുന്നതോയെന്നുള്ള അനുഭവങ്ങൾ ഉപയോഗിച്ച് നിവിച്ചറിയാൻ സഹായിക്കും.

IUCN നെയ് ലിസ്റ്റിൽ വംശനാശഭീഷണി നേരിടുന്ന ഗണത്തിലാണ് ഇവയെ ഉൾപ്പെടുത്തിയിരിക്കുന്നത്. കൂടാതെ ഇന്ത്യൻ

വന്യജീവി സംരക്ഷണനിയമത്തിന്റെ നാലാം പട്ടികയിൽപ്പെടുത്തിയിരിക്കുന്നു.
പ്രാദേശിക നാമങ്ങൾ: തമിഴ് പെരിയ മൈ,

കാടാർ-വെങ്കലാർ, കന്നട - ബെട്ട രാ. ഗുഡ
രാ. കാർ രാ
നിങ്ങൾ ഇതിനെ കാണുകയോ ഇതിനെപ്പറ്റി
രേക്കിക്കുകയോ ചെയ്തിട്ടുണ്ടെങ്കിൽ ദയവായി
സാമ്രഭക്ഷാട്ടുനിരീക്ഷുന്ന ഭരതീലാസത്തിൽ
ബാഹ്യപ്പെട്ട കയർ ഉൾപ്പെടെ നിങ്ങളായി
ബന്ധപ്പെടുന്നതാണ്.

Travancore tortoise (*Indotestudo travancorica*) is a large forest tortoise growing up to 330 mm. It primarily feeds on grasses and herbs. It also feeds on molluscs, insects, animal carcass, fungi and fruits. It occurs in hill forests at 450-850 m above sea level. Males combat by ramming their shell during their breeding season between November and March. It makes a shallow nest in the ground and lay 1-5 eggs. Hatchlings are 55-60 mm in size. The tortoise is hunted and it is threatened due to forest fires, habitat destruction and fragmentation. Identification: a scute right behind the head is absent and the second scute along the vertebral column is located at the highest point of the shell. Status: IUCN Red list - Vulnerable; India's Wildlife (Protection) Act Schedule IV. Distribution: restricted to the Western Ghats, in the states of Kerala, Karnataka and Tamil Nadu. Vernacular names: Tamil: Periya amai, Kai amai, Kadas; Vengala amai. Kannada: Betta aame, Gudda aame, Kudu aame, Malayalam: Chiuirel aama.

If you have seen or heard about this tortoise anywhere in your area, please write or contact us at the address given below and we will get in touch with you soon

Contact: Karthikeyan Vasudevan, Wildlife Institute of India, P.O. Box 18, Chandrabani, Dehradun 248001, Uttarakhand, India
Phone: 0135-2640111 to 115; email: turtle&tortoise@wii.gov.in
Photos and map: V. Deepak

Chapter 04

Distribution and Conservation Status of Assam Roofed turtle, *Pangshura sylhetensis* in Assam

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Introduction

The State of Assam is located between 24.3° N and 28° N and 89.5° E and 96.1° E and with an area of 78,438 km² representing 2.4 percent of the India's landmass. The turtle fauna of Assam is diverse comprising of *Pangshura sylhetensis* (Jerdon, 1870) commonly known as Assam roofed turtle. It is a small turtle differing from other species of *Pangshura* in having 13 pairs of marginal scutes, and attaining a carapace length of 200 mm and is endemic to northeastern region of India and Bangladesh. According to IUCN (2007), it is one of the Asia's Most Endangered Tortoises and Freshwater Turtles. The species was first reported from the Khasi hills. Study of population status, distribution pattern in an area can be used to formulate conservation strategies and taxonomic relationship among the species. This paper reports the present status and distribution of *P. sylhetensis* in Darrang, Sonitpur and Udalguri districts of Assam.

Analysis of zoogeography of *Pangshura* sp. provides information and ranges of their natural distribution and boundaries that helps to find out the endemic status of the species. Endemism constitutes an important feature while formulation of conservation strategies. Therefore distribution of the species and their habitat associations have been attempted in this study.

The study sites

The study was conducted in five sites viz. Kuruwa, Kulshi, of Darrang and Udalguri districts, Biswanath ghat, Gomirighat and Jia Bharali River in Sonitpur district of Assam, India (Table-1).

Jia Bharali river: This study sites under the river Jia Bharali and its tributaries are Diji, Dinai, Doigurung, Nameri, Dikori and Khari criss-cross of Nameri National Park (200 sq km).

Biswanath ghat: It is popularly known as "Gupta Kashi" located at the confluence of Bridhaganga (Burigonga) river with the Brahmaputra.

Gomirighat: It is on the north bank of the river Brahmaputra, adjacent to Ghanhigaon in Sonitpur District.

Kuruwa ghat: It falls under Kuruwa Reserve Forest (155 Ha) is located on the north bank of the river Brahmaputra.

Kulshi river: It is at the North border of Udalguri touching foothills of Bhutan falls Khalingduar Reserve Forest (7033 Ha).

Table-1: The Survey Areas

Survey area	Geographical location		Type of vegetation
	Longitude	Latitude	
Jia Bharali River	26°55'20.22"N	92°50'27.12"E	Semi evergreen forest
Biswanath Ghat	26°46'30.74"N	93°32'04.86"E	Evergreen and Semi evergreen forests
Gomirighat	26°44'47.93"N	93°38'45.45"E	Evergreen and Semi evergreen forests
Kuruwa Ghat	26°13'32.79"N	91°46'39.74"E	Semi evergreen forests
Kulshi River	26°45'30.74"N	92°02'51.38"E	Evergreen and Semi evergreen forests



Methods

The study was conducted in different representative ecozones of northern part of the River Brahmaputra valley of Assam during January 2004 - December 2007. Extensive surveys in 3 districts of Assam, India were made in different seasons. Surveys were also done in Buffer Zones of Protected areas considered important by earlier workers.

The survey for *Pangshura sylhetensis* habitat was done using quadrats; transects, museum records and interviews with local people using photo sheets and questionnaires.

The study area was censused one to three times per day between 7a.m. to 5 p.m. in winter, premonsoon and postmonsoon season. Searching for nests was carried out by walking an 1.5 Km transect in 2 hrs. Local fishermen gave information about nest and eggs of *P. sylhetensis*.

During survey period most turtles were marked with red paint on the plastron and released in the same area. For identification of the species Das (1995) was followed.

Live turtles were collected and without causing any injury, measured for curved carapace length (CCL), straight carapace length (SCC) curved carapace width (CCW) and shell height (SH). Scute and bone terminology used by Zangerl (1969) was followed.

Dead specimens collected from the study sites were preserved and measured for curved carapace length (CCL), straight carapace length (SCL), curved carapace width (CCW), shell height (SH) and body weight.

Results and discussion

A total of 136 representatives of *P. sylhetensis* belonging to the family Geoemydidae have been collected from study sites and released after investigation (Plate 4A and 4B). Eight dead specimens of *P. sylhetensis* were collected from Biswanath ghat and Gomirighat.

The present field survey has identified the following important habitats for *Pangshura sylhetensis* in Darrang, Udalguri and Sonitpur districts of Assam-

Darrang district: Poska phukhuri near Barampur, Dighirpar phukhuri near Arjuntal, Marasuti of Mangaldoi river near Karimchowka, Beel near Shiv temple of Kuruwa ghat, Beel near Ganesh Kuwari of Dumuni chowki, Khalihoi beel, Rowmari, Chereng and Mowamari beel, Dova near areng of Darrang district.

Udalguri district: Dhansirighat, Mara-dhansirighat, Pond of Rawta charali, Kachubeel, beel near Orang National Park, Namkhala bazaar area of Udalguri district.

Sonitpur district: Nameri National Park, beel near Beseria village, near Gabharu river, Gahigaon wetland, Gohpur wetland of Sonitpur district of Assam.

These observations resulted from the catch of 136 turtles during the study period (male 81 and female 55) (Table-2). Further, 50 juvenile male's and 20 juvenile females were observed during this study. This confirms the suitability of this habitat as having a breeding populations. Habitat destruction and over exploitation have threatened the survival of this species. Indian population of *P. sylhetensis* suffered a 90% decrease in the last decade and IUCN justifiably declared this species as endangered (IUCN, 2007). But present investigation documents a healthy population of *P. sylhetensis* in Nameri National Park, Biswanath ghat, Gomirighat and Kuruwa ghat areas, probably due to the level of protection and awareness among locals.

Nests of *P. sylhetensis* were observed only in March/ April at Biswanath ghat and Kuruwa ghat with 6-8 eggs per nest. During this study period, three new habitats were located and their physiochemical parameters were recorded.

Table-2: The abundance of *P. sylhetensis* in the study sites.

Year	JB	GG	BG	KG	KR
2004	8	6	6	4	-
2005	10	6	6	6	Shell
2006	14	8	10	6	Shell
2007	18	8	12	8	Shell
Total	50	28	34	24	-

JB: Jia Bharali River (total 50 specimens: 30 M and 20 F)
GG: Gomirighat (total 28 specimens: 17 M and 11 F)
BG: Biswanath Ghat (total 34 specimens: 20 M and 14 F)
KG: Kuruwa Ghat (total 24 specimens: 14 M and 10 F)

Our survey shows that every year during the period from the first week of October to first week of February, a huge numbers of eggs of *P. sylhetensis* are collected by the inhabitants (particularly by children) and sold in the local market. Other reasons for the decline of the species are illegal slaughtering for meat, egg perdition, water pollution and human disturbances (Rao, 1985 and Gupta, 2000). The killing of adult female freshwater turtles and incidental catch of breeding adults has probably increased over the past few years. The nest poachers can easily identify the nests and dig out the eggs and sell these in the local markets.

Earlier, *P. sylhetensis* was recorded from Kukurmara and Chandubi beels of Kamrup district; Kalathua village of Sibsagar district; Rupali Bhumuk of Manas National park; Barpeta district, Kundil river of Sodia; Banko beel of Dibru-Saikhowa Wild Life Sanctuary; Lohit river near Saikhowaghat, Tinsukia district; Ghilamara of Lakhimpur district and Nameri National Park, Sonitpur district of Assam. Cachar district of Assam, Garo, Khasi and Naga hills.

Moll (1986) had reported *P. sylhetensis* from Cherrapunji (Khasi hills) and Garo hills of Meghalaya, Cachar dist. of Assam. Coudhury (1995) reported the new locality of *P. sylhetensis* in Sadiya, subdivision of Tinsukia district, Kolathua village of Sibsagar district, Assam. Choudhury *et al.* (1997) described the distribution and diet of *P. sylhetensis* in Assam. They conducted a survey between March 1995 to August 1996 in Kamrup district, Assam, north eastern India to ascertain the distribution of the species. They collected *P. sylhetensis* from Kukurmara river and Chandubi beel located in the south western part of Kamrup district. Praschag and Fachbach (2001) reported *P. sylhetensis* from Nameri National Park of Assam, India. This species has been reported from various locations from the Northeastern region in the past (Tikadar and Sharma 1985, Choudhury 1995, Choudhury *et al.* 1997).

Conclusion

The survey shows that vast areas of their original habitats have been lost. Amongst all the study sites surveyed, Jia Bharali seems to be an ideal home for *P. sylhetensis*. Other reasons for the decline of the species are illegal slaughtering for meat, poaching of egg, water pollution and by-catch. Killing of adult freshwater turtles and incidental catch of breeding adults has intensified over the past few years. Hence, there is an urgent need to sensitize and educate the people about the significance of chelonians and their conservation.

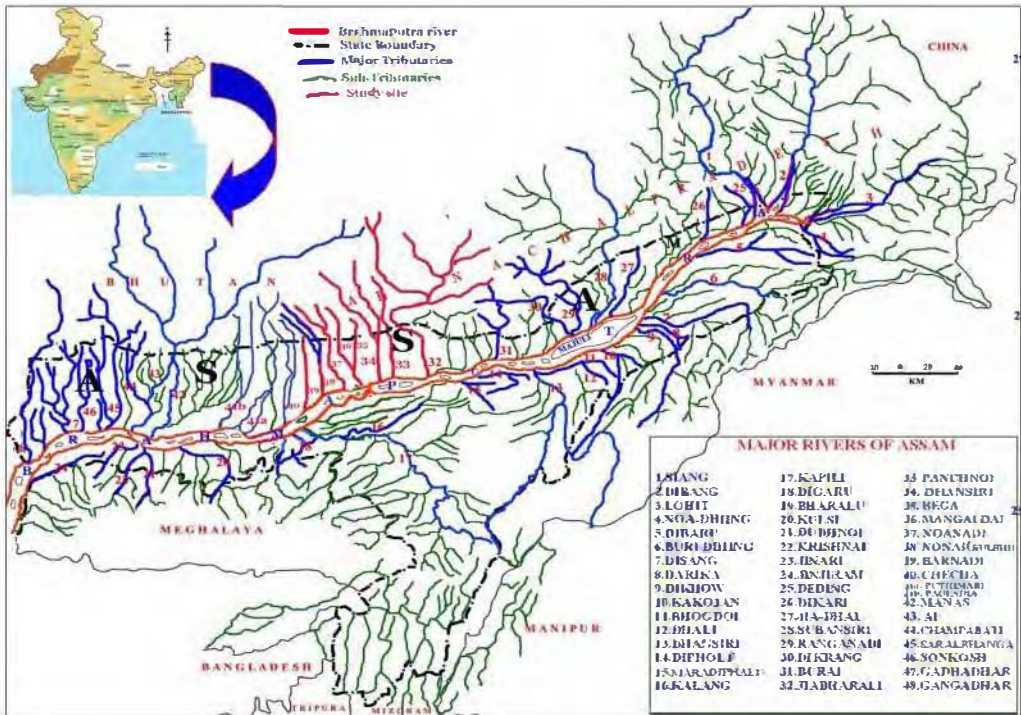
Acknowledgements

We thankfully acknowledge the Forest Officials, Government of Assam for the accord of necessary permission and help during the field work. We are also thankful to Rufford Small Grants Foundation, U.K and UGC, NERO, Guwahati for financial assistance.

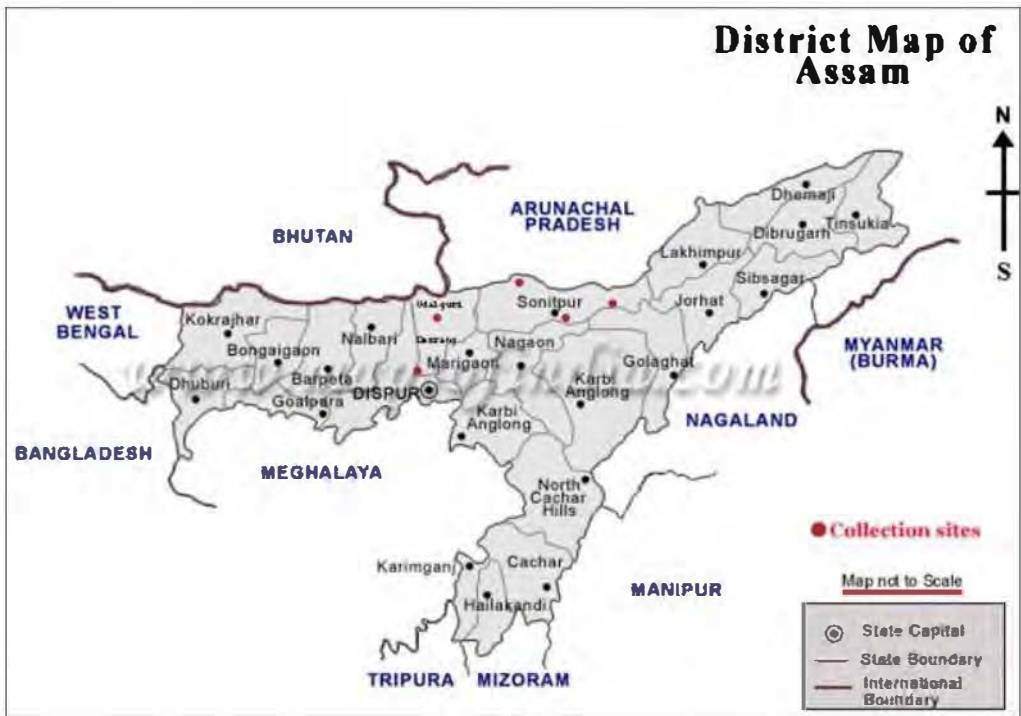
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Plate 4



(A)



(B)

(A): Major rivers of Assam along with the study sites (red colored) and (B): Map of Assam along with collection sites (red colored)

Turtles and Tortoises in Manipur

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Introduction

The State of Manipur is located between latitude 23°83'N – 25°68'N and longitude of 93°03'E – 94°78'E with an area of 22,347 km² (Plate 5.1 A). It forms part of the Indo-Burma global bio-diversity hotspot. It is also one of the most threatened biodiversity hotspots due to the rate of resource exploitation and habitat loss. However, the area has remained relatively unexplored owing to its difficult mountainous terrain.

Chelonian status

The records of chelonians in the region include ten species of turtles and tortoises (Table 1) viz. *Cyclemys dentata* that occurs in the hills of Ukhrul, Tamenglong and Jiribam regions; *Cuora mouhouti* and *Cuora amboinensis* from Loktak lake and its adjoining wetlands; *Pangshura tentoria* from the Barak river and its tributaries, Lamphelpat, Imphal East district and *Nilssonina hurum* in Jiri, Barak and Makru rivers and Yangoupokpi-Lokchao Wildlife Sanctuary (Shamungou, 1987; Arunkumar and Singh, 1990 and Salam Rajesh, 2006). Recent field surveys conducted by the first author recorded five species for the first time from the region which include *Amyda cartilaginea*, *Cyclemys gemeli*, *Indotestudo elongata* (Plate 5.1 B), *Manouria emys* (Plate 5.1 C) and *Morenia petersi*. In addition to this, *Cuora mouhouti* and *Cuora amboinensis* have been reported from new localities viz. Siguilong village, Imphal-Jiribam road and Moirang, Mayang Imphal respectively. This emphasizes the need for a detailed study and redefining of range records for Chelonians in the state of Manipur.

Amyda cartilaginea was reportedly caught in the river Makru and sold in the local market of Tamenglong bazaar (Plate 5.1 D). Three more individuals of *Amyda cartilaginea* were reported from Imphal river (Plate 5.1 E). Two individuals of the Indian leaf turtle (*Cyclemys gemeli*) (Plate 5.2 A) from Chandel district and twenty two individuals of box turtles (Plate 5.2 B) from Imphal river and Loktak lake were recorded between May 2008 - April 2010. Recently the Indian eyed turtle (*Morenia petersi*) has been recorded from Chingmeirong, Imphal East District (Plate 5.2 C).

Manipur has certain areas rich in freshwater chelonian diversity which include the Loktak lake as the prime habitat of the box turtles, Keibul Lamjao National Park, the Yangoupokpi Lokchao Wildlife Sanctuary, the Barak river, Jiri river and its tributaries in the Assam-Manipur border, the Makru river in Tamenglong district of Manipur, the Ningthi river in Chandel District, the Imphal river that flows through the Imphal valley and in small rivulets in the hilly areas of Churchandpur, Ukhrul and Senapati districts. There are many regions that are yet to be explored in the State.

Salam Rajesh of Manipur Nature Society gave a brief estimate of the beleaguered chelonians that were rescued and released by the members of the People for Animals, Manipur. Approximately 15 -20 representatives of *Cuora amboinensis* (Box Turtles) were rescued from the Thanga-Karang area market in Bishenpur district and released in its natural habitat at Loktak Lake (Plate 5.2 D). Box turtles were mainly exploited in the local market for meat and for pets and large numbers are bought and sold in local markets. The conservation of turtles and tortoises in the State of Manipur is in its infancy with very few organizations involved in turtle conservation in the region.

Habitat loss and exploitation

Changes in the hydrological regimes due to the construction of Ithai barrage in the Loktak lake may affect the turtle population and migration in the region and adjoining wetlands. Deforestation and the resultant loss of soil, especially in the hill areas, are also leading to increase siltation of rivers and streams. The deep pools that are the favored habitats of many species, are rapidly becoming shallow and choked with silt, leading to a decline in habitat. At the same time, swamps, marshes, and other wetlands are being reclaimed for urban and agricultural expansion. These changes are reflected in sharp decline of chelonian density. The Ningthouja clan of the Meiteis of Manipur, for example, considered it a taboo to consume turtle or tortoise meat (Gupta and Guha, 2002). Unfortunately, a rapid incursion of consumerist culture and the lure of easy money are making this market unsustainable. There is an urgent need for the set up of a cell for conserving the dwindling and still unexplored chelonians of Manipur. Illegal hunting and mindless exploitation by the locals still goes unnoticed due to the lack of awareness among them.

Conclusion

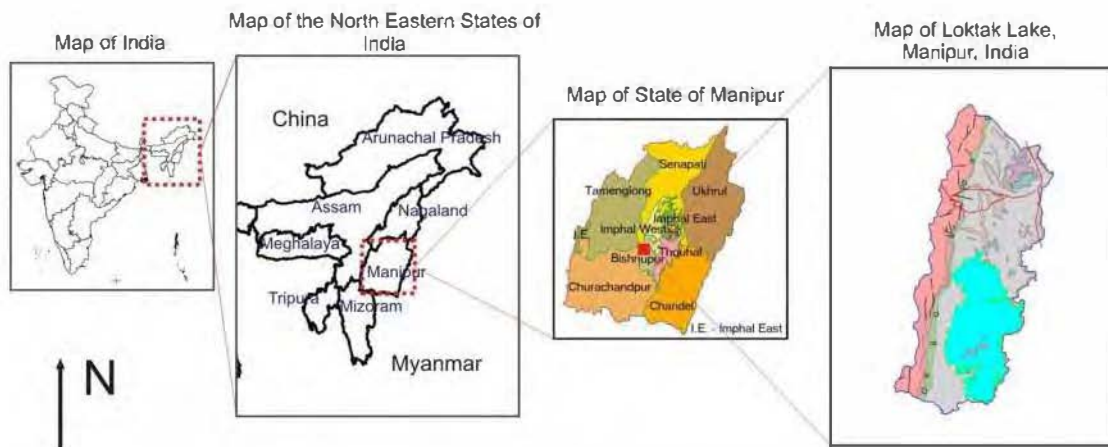
During the study *Cuora amboinensis* was the most abundant among all chelonians in the State. Loktak lake and its adjoining wetlands has been identified as a potential habitat of the box turtles. A significant find during the study is the report of the giant softshell turtle *Amyda cartilaginea* of the family Trionychidae in two districts of Manipur and that of the Indian eyed turtle (*Morenia Petersi*) from a hillock near Chingmeirong in Imphal East district. The turtle population in the state of Manipur remains poorly studied and other general reasons for the possible decline of some species are illegal exploitation for meat and eggs, water pollution and human disturbances (Gupta, 2000). It is expected that a more meaningful study of the distribution and status of chelonian diversity of the state of Manipur will be undertaken for their exploration and effective conservation.

Name of the species	Locality	Source
<i>Cuora amboinensis</i>	Loktak lake and its adjoining wetlands, Bishenpur District Loktak lake and its adjoining wetlands, Moirang, Bishenpur District; Mayang Imphal, Thoubal District; Moreh Market, Chandel District Thangga-Karang of Loktak lake, Moirang, Bishenpur District	Shamungou (1987) Photos and documentation by Naorem Linthoi (2007-2010) Salam Rajesh (2006)
<i>Cuora mouhotii</i>	Loktak lake and its adjoining wet lands, Bishenpur District Siguilong village, Imphal-Jiribam road, Tamenglong District	Shamungou (1987) Found by locals (documented by Naorem Linthoi, 2008)
<i>Morenia petersi</i>	Chingmeirong, Imphal east	Encountered by locals near a hillock (Photo: Naorem Linthoi, 2010)
<i>Amyda cartilaginea</i>	Naga river (a tributary of Nambul river), Laipham Khunou, Imphal East district; Imphal river Tamenglong bazaar, near Makru river, Tamenglong district Nambul river, Imphal	Naorem Linthoi (June, 2008) Sangai express (local newspaper, December, 2008) Photo identification by Naorem Linthoi Shamungou and Manipur Forest Department officials (2009)
<i>Pangshura tentoria</i>	Barak river and its tributaries Lamphelpat, Imphal east	Shamungou (1987) Salam Rajesh (2006)
<i>Manouria emys</i>	Found in Manipur (But locality yet to be confirmed)	Manipur Zoological Garden, Iroisemba (Photo: Naorem Linthoi, 2009)
<i>Indotestudo elongata</i>	Lamka, Churachandpur District	Encounter of a "shell" in a marshy area by locals (Photo: Naorem Linthoi, 2010)
<i>Nilssonina hurum</i>	Yangoupokpi-Lokchao Wildlife Sanctuary, Indo-Myanmar border Jiri, Barak and Makru rivers	Arunkumar and Singh (1999) Shamungou (1987)
<i>Cyclemys dendata</i>	Hills of Ukhrul, Tamenglong and Jiribam regions	Shamungou (1987)
<i>Cyclemys gemeli</i>	Moreh bazaar and Monshang Panthak village near Chakpi river, Chandel District	Encountered by locals (Naorem Linthoi, 2008)

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Plate 5.1



(A)



(B)



(C)



(D)



(E)

(A): Map of Manipur, India; (B): A yellow tortoise (*Indotestudo elongata*) from Lamka, Churchandpur district; (C): Asian Brown Tortoise (*Manouria emys*); (D): A soft-shell turtle put up for sale in Tamenglong bazaar (December 5, 2008); (E): Soft-shell turtle from the

Plate 5.2



(A)



(B)



(C)



(D)

(A): Indian Leaf Turtle; (B): Box Turtle; (C): *Morenia petersi* from Chingmeirong, Imphal East District; (D): Box turtles rescued and rehabilitated by the members of People for Animals at Keibul Lamjao National Park, Loktak lake, Manipur (2006). Photos (A, B and C) by Naorem Linthoi.

Chapter 06

Distribution and Status of the Endangered River Terrapin *Batagur baska* (Gray) in the Indian Sunderbans

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Introduction

The River Terrapin (*Batagur baska*) has been one of the most exploited estuarine turtles over the centuries. This terrapin inhabits the lower reaches of the major rivers of tropical Asia and is reported from Vietnam, Cambodia, Sumatra (Indonesia), western Malaysia, Thailand, Myanmar, Bangladesh and eastern India.

Morphology and Taxonomical Characteristics

Common English Names

River terrapin, Batagur turtle, Four-clawed terrapin.

Vernacular Names

Bali katha (sand turtle), Bala katha (girl turtle), Boro katha (big turtle) and Ram katha (huge turtle).

Size

up to 600 mm.

Morphology

Head small, forehead covered with small scales, snout upturned, upper jaw notched. Carapace domed and heavily buttressed. Scutes smooth, marginals unserrated in adults. In juveniles, marginal scutes are modified into spine-like projections and shells are comparatively more flat. Fontanelles present in both carapace and plastron and carapace possesses a low interrupted keel, all of which disappear with growth. Vertebrae broader than long, nuchal small, broader than long. Plastron long, truncated anteriorly and notched posteriorly. Four claws on each forelimb.

Colour

Carapace olive-grey or brown, head of the same colour but lighter on the sides. Plastron yellow, unpatterned. When breeding, skin at the back of the head and on the forelimbs in the males turn bright red and the area around the nostrils turn pale blue (Das 1995).

Sexual Dimorphism

Females are larger, attaining 600 mm in carapace length, while males reach up to 500 mm. Females also have a proportionately higher shell, longer plastron and shorter tail besides being lighter coloured (Das 1995).

Habit and Habitat

Habitat

The river terrapin occurs at the mouths of large rivers (estuaries) (Plate 6A), canals and coasts near river mouths that are under tidal influence and are having some mangrove vegetation.

Diet

Fruits of *Sonneratia*, a mangrove plant is an important food item. Leaves, stems and fruits of other mangrove plants are also consumed besides pelecypod mollusks, crustaceans and fish. The double serrated beak on the upper jaw cuts up the plant materials and functions in the manner of a rachet to permit large leaves to be progressively moved into the oesophagus. Most feeding occurs at high tide when leaves and fruits from low-hanging branches become more readily accessible from the water (Das, 1995).

Reproduction

River terrapins nest on the sandy coast in the Sunderbans of India and Bangladesh and also in Myanmar due to the absence of sand banks up the course of the river. In Malaysia, these terrapins travel 80-95 km up river from foraging grounds to nest on sand banks and sandy islands where they nest in groups, 2-23 m from the river bank. A body pit is excavated, using both the fore and hind limbs and about 75 minutes is spent hiding the nest site (Moll 1980). Clutch size ranges from 5-38. However, in Myanmar river terrapins lay 50-60 eggs in three clutches between January to early March generally during full moon but sometimes during the day (Maxwell 1911). Eggs are elongated and brittle-shelled, averaging 65 X 40 mm and weighing 64g. Eggs take 66-81 days to hatch in Malaysia (Moll 1980). In the Indian Sunderbans, a clutch comprises 19-37 eggs, averaging 68 X 40 mm and weighing 70g. Eggs on the sandy beaches in the Sunderbans on the Bay of Bengal coast are laid between the end of February and early March in a flask-shaped nest 300-400 mm deep about 25-160 m from the high-tide line. The incubation period ranges from 61-68 days at 24-33°C. Mean carapace length is 60 mm and weight of hatchlings is 45 g (Ghosh and Mandal 1990).

Distribution and Status

Distribution and Status outside India:

The distribution and status of this species outside India is not well known. In Malaysia, this terrapin is found only at the mouth of large rivers. The decline in its population in Perak rivers was documented by Loch (1950), Mohd Khan (1964), Moll (1980) and Siow and Moll (1982). Habitat destruction is a very important factor for the decline of this terrapin in Malaysia. Wirot (1979) pointed out that the Thailand population is heavily exploited and possibly extinct now. Maxwell (1911) reported its numbers as declining at the mouth of the Irrawaddy River in Myanmar where it is presumed to be extinct now. In Bangladesh, the species was discovered much later in 1982 (Khan 1982).

Distribution and Status in the Sunderbans of Bangladesh and West Bengal:

The River Terrain is restricted to the estuary of the Ganga and Brahmaputra, which forms the largest mangrove swamp in the world – the Sunderbans. It nests in the southern part of Chandpai and Sarankhola Ranges of Bangladesh Sunderbans, on the Sipsah, Katka and Kaga creeks and on Kalichar and Passur Island. The species is also suspected to occur in the Inani area of Teknaf, Cox Bazar district (Khan 1982). Specific localities in the Indian Sunderbans where the species nests are the sandy beaches along the West Bengal coast: Kalash, Mechua, Kedo, Nagbarachar, Chaimari and Narayantala (Das 1995 and personal observations). The species also occurs in the Bhitarkanika area (Brahminy-Baitarani delta) and at the mouth of the Subarnarekha River in Orissa (Das 1995).

Threats and Conservation Value

River terrapins are caught for food in the Sunderbans of Bangladesh and India. In Bangladesh, they are caught during the monsoons from May to August using hooks baited with *Sonneratia* fruit. The Hindus consume the flesh, since Muslims consider the flesh of all amphibious vertebrates as 'haram' (unclean). A big terrapin over 15 Kg will sell for up to Rs 500. However, the eggs are relished by all communities and predation of the nests in the Sunderbans is a major threat to the species. In the Sunderbans of West Bengal, the river terrapin is caught in 'bagda jal' (tiger prawn nets). These are long, funnel-shaped nets, the wide mouths of which are strung between two long poles anchored in the river bed and facing the direction of the current. Sometimes, these turtles are kept as pets and survive on a variety of plants for over 20 years (Das 1995).

Batagur turtle was formerly abundant at the mouth of the Hooghly / Ganga river (Gunther 1864) but they were captured in large numbers in the mid 19th Century and transported to Calcutta for making turtle soup as a substitute for sea turtles especially in those months of the year when sea turtles were not available. Previously, the fat was in much demand for the manufacture of soap.

Presently the species is listed as critically endangered (www.iucnredlist.org) in the IUCN Red Data Book, protected under Schedule I of the Indian Wildlife (Protection) Act, 1972 and included in Appendix I of CITES indicating that all forms of exploitation is banned.

Research and Management Requirements

Very little surveys and research have been done on the Batagur terrapin in the Indian Sunderbans. The first survey was done by Indraneil Das in the 1980s and then again by S. Bhupathy in 2000. The West Bengal Forest Department personnel however got three nests of this River terrapin while collecting eggs of Olive Ridley sea turtles on the sandy beaches along the coasts of the Sunderbans between the end of February and early March, 1988. They reared these eggs in their hatchery at Sajnekhali in the Sunderbans. The incubation period ranged from 61-68 days at 24-33°C.

As this terrapin species has become very rare, there is urgent need of further research both in the wild and in captivity. Hatcheries need to be constructed in the Indian Sunderbans where the species should be reared and later released into the wild to build up a viable population in future.

Concluding Remarks

The species has become endangered due to exploitation for its flesh and fat, collection of its eggs for human consumption and loss of nesting beaches.

Although there is no record available regarding the population density and abundance of this species in the entire Sunderbans, over-consumption has led to the rapid decline of the Batagur River Terrapin in the Indian Sunderbans to the point that they are hardly sighted now.

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Plate 6



(A)

(A) *Batagur baska* on a beach. Photo by Dr. Indraneil Das

Chapter 07

Tortoises and Freshwater Turtles of Kaziranga National Park, Assam – Diversity, Distribution, Conservation Status.

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Introduction

The northeastern region is a 'Hotspot' of tortoises and freshwater turtles within India with 21 species found in the region out of 29 species known to occur in the country (Ahmed *et al.*, 2009). Very little is known about the chelonians of the region. This is evident that even new species of turtles were described from the region recently (Fritz *et al.*, 2008) and also species added to Indian chelonians not known earlier (Pawar and Choudhury, 2000). Very few efforts have been made to scientifically study the chelonians of the region. Some of the notable works that addressed the region are Fritz *et al.* (2008), Pawar and Choudhury (2000), Das (1990), Prachag and Gemel (2002), Sengupta *et al.* (2000), and Choudhury (1995). Sadly, the tortoises and freshwater turtles of the region are facing extinction due to excessive hunting for meat and rapid loss of habitat. Even they are extirpated in most part of the region from outside well protected conservation areas. Being one of the best protected areas, Kaziranga National Park and its surrounding Reserve Forests presumably represent the best Turtle habitat left in the region. Although very little is known about this bewildering chelonian diversity of Kaziranga National Park.

Methodology

The study was carried out during January through December 2004 (followed by random visits till March 2009), with an aim to determine the diversity and natural history information of turtles and tortoises in and around the Kaziranga National Park (Table-1). The study area included the notified National Park area, nearby reserved forests plantations and the fringe areas including tea gardens, paddy and human habitations.

Field surveys were carried out during day time. During the extensive survey, we carried out visual inspection of forest floor, shrubberies, grasses and wetlands. All possible ecotones were searched thoroughly including such microhabitat as puddles and springs and along the streambeds, wetlands, aquatic vegetations, basking areas, under loose barks and logs, bases of buttressed trees, under rocks, accumulated debris and such areas which often attract turtles and tortoises for food, shelter or breeding.

We looked for turtles and tortoise from 0800 h to 1200 h and in the afternoon 1400 h till dusk. While looking for basking or active reptiles we visually mapped the habitat to be surveyed in the afternoon.

Occasionally turtles at distant locations were observed through binoculars (20x50) and spotting scope (40X). Whenever possible individuals were caught, photographed and measured for future reference before releasing back. Turtle shells were collected from different localities and camps inside the park and also from the villages.

Data sheet was filled in to record - date, time, specific locality, latitude, longitude and altitude (recorded using a Garmin 12 channel GPS), habitat type, habitat description, morphological measurements, weather such as temperature and humidity, detailed live coloration and natural history as well as other important field notes were taken for most of the animals we observed. Photographs were taken in natural condition for additional information. Forest staffs based in the camps inside the park and communities living in the fringe villages were interviewed to get more information about turtles.

Taxonomy and nomenclature follows Das (2002, 1995), Prachag and Gemel (2000), Prachag *et al.* (2007a and b, 2009), Fritz *et al.* (2008), Fritz and Havas (2007).

Table-1: List of localities along with geographical coordinates where turtles were observed in and around Kaziranga NP, Assam.

Locality	Range HQ/Area	Coordinates
Ahotguri	Agoratoli	26° 43' 10.59" N, 93° 28' 43.54" E
Bhengrai Nullah	Agoratoli	26° 42' 37.21" N, 93° 29' 50.23" E
Debeshwari	Agoratoli	26° 44' 34.97" N, 93° 27' 19.05" E
Rongamatia Beel	Agoratoli	26° 41' 52.22" N, 93° 31' 05.65" E
Donga Beel	Bagori	26° 35' 18.67" N, 93° 16' 26.84" E
Gandermari	Bagori	26° 36' 15.68" N, 93° 16' 24.52" E
Roumari	Bagori	26° 35' 58.24" N, 93° 17' 52.92" E
Sapekhati Beel	Bagori	26° 36' 45.43" N, 93° 17' 03.90" E
Biswanath Ghat	Biswanath Chariali	26° 39' 31.49" N, 93° 10' 18.92" E
Bagsher RF	Buhrapahar	26° 33' 14.71" N, 93° 06' 05.74" E
Arimora	Kohora	26° 40' 59.99" N, 93° 20' 26.43" E
Bokpara camp	Kohora	26° 36' 51.43" N, 93° 21' 19.22" E
Borbeel Camp	Kohora	26° 36' 08.09" N, 93° 20' 51.64" E
Borbeel (Arimora)	Kohora	26° 40' 55.18" N, 93° 20' 27.40" E
Buruntika Beel	Kohora	26° 38' 48.96" N, 93° 21' 59.57" E
Daflang Beel	Kohora	26° 38' 04.92" N, 93° 21' 29.27" E
Hulalpath	Kohora	26° 36' 15.68" N, 93° 16' 24.52" E
Mihi Beel	Kohora	26° 36' 50.20" N, 93° 22' 31.86" E
Mihimukh Grassland	Kohora	26° 36' 26.71" N, 93° 23' 12.02" E
Panbari RF	Kohora	26° 36' 49.51" N, 93° 31' 19.08" E
Diffolu River	Kohora	26° 38' 21.22" N, 93° 20' 36.57" E

Abbreviation used

- SCL= straight carapace length
- SCW= straight carapace width
- PL= plastron length
- PW= plastron width
- RF= reserve forest
- KNP= Kaziranga National Park.

Study site

The Kaziranga National Park (26° 34' N to 26° 46' N and 93° 08' E to 93° 36' E) covers civil jurisdictions of Nagaon and Golaghat districts in Assam (Plate 7.1 A). The Brahmaputra River flows by the northern boundary and Karbi Anglong hills stands to the south. Thickly populated villages bound the east and west boundaries of the park. The total area of the park is 860 km². The park and neighbouring Laokhowa and Buhrapahar Wildlife Sanctuary together notified as the Kaziranga Tiger Reserve that covers an area of 1033 km².

The alluvial deposits of the Brahmaputra River formed most of the park area (Vasu, 2003). The River also continuously forms and removes river islands, a very dynamic process. The newly formed islands are initially colonized by *Saccharum* and other grass species that are slowly succeeded by tree species as they stabilize. Numerous channels (old and new) of the Brahmaputra and Diffolu River crisscross the entire park and had formed wetlands of various sizes and depth. Altogether, there are 191 wetlands or beels in the park. The Diffolu River originating from Karbi Anglong Hills flows east to west and divides the park in two sections before merging to the Brahmaputra. Altogether there are 58 rivers, rivulets and streams in the drainage systems of the park.

Kaziranga NP has the largest population (2048 individuals, Data Source: Park Authority, 2009) of Indian one-horned rhinoceros (*Rhinoceros unicornis*). The park is also a safe heaven for Asian elephant (*Elephas maximus*),

swamp deer (*Cervus duvaucelli ranjitsinghi*), Asiatic water buffalo (*Bubalus arnee*), and tiger (*Panthera tigris*) that are significant from conservation point of view. This park is also home to some 490 species of birds (Barua and Sharma, 1999; Choudhury, 2004). Previous surveys recorded thirteen species of tortoises and freshwater turtles from the park (Das, 1990; Choudhury, 2004). However, this was the first ever extensive scientific study carried out to evaluate species richness, status and conservation of the chelonians in the Kaziranga NP.

Climate

The climate of the park is tropical monsoon with four distinct seasons: dry winter (December-February), Pre-monsoon (March-May), Monsoon (June-August) and Post-monsoon (September-November). Annual rainfall varies from 2000-2900 mm, more than 70% of the rainfall occurs during the monsoon alone.

Temperature ranges from minimum 7°C in winter (with low humidity) to maximum 35°C in summer (with high humidity). A comparatively dry season is observed in the park during January through April. The wettest months observed are June through August and during this period the park is inundated more than once.

Vegetation

The vegetation of the park can be classified into grassland (66%), woodland (28%) and aquatic vegetation (6%) (Marry *et al.*, 1998). The wet alluvial grasslands in Kaziranga NP also known as 'elephant grass' generally grows up to a height of five meter during monsoon season and are dominated by grass species like *Erianthus ravennae*, *Imperata cylindrica*, *Saccharum elephantanum*, *Saccharum spontaneum*.

Low lying and marshy areas are covered by *Arundo donax*, *Phragmites karka*, *Alpinia allughas*, *Cynodon dactylon*, *Egrotis* spp., *Crysopogon* spp. Woodlands of the park are characterized by some evergreen patches on the high grounds often with cane brakes and scattered trees among grasslands and are dominated by species like *Albizia procera*, *A. odoratissima*, *A. lucida*, *Bombax ceiba*, *Aesculus pandana*, *Premna latifolia*, *P. bengalensis*, *Lagerstroemia parviflora*, *L. flos reginae*, *L. speciosa*, *Tetrameles nudiflora*, *Ficus religiosa*, *F. glomerata*, *F. bengalensis*, *Dillenia indica*, *Cedrela toona*, *Sterculia villosa*, *Terminalia belerica*, *Artocarpus chaplasi*, *Oroxylum indicum*, *Salix tetrasperma*, and *Schima wallichii*. *Bombax ceiba* and *Ziziphus jujuba* are found scattered all around the grasslands.

The vegetation along the wetlands of the park are dominated by *Eichhornia crassipes*, *Andropogon* spp., *Ipomoea reptans*, *Enhydra fluctuans*, *Pistia stratiotes*, *Nymphaea lotus*, *Enhydra fluctuans*, *Pistia stratiotes* and *Nelumbium speciosum*.

Located on the flood plain of the Brahmaputra River, annual flooding is a natural phenomenon in the park. The park area is inundated usually more than once by surging water of the rivers annually.

As a management practice, the grasslands are burned annually to benefit the herbivores, as they are attracted to feed on resprouting grasses followed by burning. The burning is believed to arrest the succession process from grassland to woodland (Vasu, 2003; Kushwaha and Unni, 1986).

Results

Out of 21 species of chelonians known to occur in northeast India (Ahmed *et al.*, 2009) as many as 17 species (Table-2) are recorded from in and around the park. As many as 14 species of the turtles found in and around the park are globally threatened, including 1 Critically Endangered (CR), 6 Endangered (EN) and 7 Vulnerable (VU). This study recorded two species of turtles for the first time from the park. Importantly, all the four species of large Softshell turtles known to occur in the region, *Nilssonia gangetica*, *N. hurum*, *N. nigricans* and *Chitra indica* are found in the park and adjoining the Brahmaputra River. Population of the chelonians outside the park is very thin or non existent as habitat is altered or disturbed and very often large individuals are killed for meat.



Table-2: Tortoises and freshwater turtles recorded from in and around the Kaziranga National Park, Assam (Plates 7.2 and 7.3).

S.No	Scientific Name	Common Name	IUCN Status	Schedule of Wildlife Protection Act, 1972	Remarks
FAMILY: TESTUDINIDAE					
1	<i>Manouria emys</i>	Asian Brown Tortoise	EN	Schedule IV	Recorded based on Choudhury (2004).
FAMILY: TRIONYCHIDAE					
2	<i>Chitra indica</i>	Narrow-headed Softshell Turtle	EN	Schedule IV	--
3	<i>Lissemys punctata andersonii</i>	Indian Flapshell Turtle	NA*	Schedule I	--
4	<i>Nilssonia gangetica</i>	Indian Softshell Turtle	VU	Schedule I	--
5	<i>Nilssonia hurum</i>	Peacock Softshell Turtle	VU	Schedule I	--
6	<i>Nilssonia nigricans</i>	Black Softshell Turtle	CR	Not listed	First record from KNP
FAMILY: BATAGURIDAE					
7	<i>Cuora amboinensis</i>	Malayan Box Turtle	VU	--	--
8	<i>Cuora mouhotii</i>	Keeled Box Turtle	EN	Not listed	First record from Kaziranga area.
9	<i>Cyclemys gemeli</i>	Indian Leaf Turtle	NA*	Not listed	--
10	<i>Geoclemys hamiltonii</i>	Spotted Pond Turtle	VU	Schedule I	--
11	<i>Hardella thurjii</i>	Crowned River Turtle	VU	Not listed	--
12	<i>Pangshura smithii</i>	Brown Roofed Turtle	NT	Not listed	--
13	<i>Pangshura sylhetensis</i>	Assam Roofed Turtle	EN	Schedule I	--
14	<i>Pangshura tecta</i>	Indian Roofed Turtle	NA*	Schedule I	--
15	<i>Pangshura tentoria</i>	Indian Tent Turtle	NA*	Not listed	--
16	<i>Melanochelys tricarinata</i>	Tricarinate Turtle	VU	Schedule I	--
17	<i>Morenia petersi</i>	Indian Eyed Turtle	VU	Not listed	Not observed during the study

Species Account:

The following section describes the distribution of the species in Assam and its status in the park as well as in the state.

1. *Manouria emys*, Asian Brown Tortoise: EN. Not encountered during the survey. Choudhury (1996, 2004) reported it from nearby Karbi Anglong Hills. The subspecies *Manouria emys phayeri* is reported from Nongkhelym Wildlife Sanctuary of Meghalaya (Das, 1991), Maibong, Langting-Mupa RF of North Cachar

Hills, Loomajooting of Nagaland (Anderson, 1871, 1872) Barail Wildlife Sanctuary (Das, 2009), and Nengpui Wildlife Sanctuary, Aizwal of Mizoram (Pawar and Choudhury, 2000; pers. obs.) and Motbung of Manipur (pers. obs.), state in the region. All these localities are on the south of the River Brahmaputra. *M. emys* is known to inhabit evergreen and bamboo forest. Pawar and Choudhury (2000) obtained specimen from thick leaf litter of moist *nullah* during February. Das (1995) also mentioned that the species inhabit tropical moist, evergreen forests close to water. A large growing tortoise extensively hunted for its meat. Though information on population is not available, this species is facing extinction due to overexploitation and severe habitat fragmentation throughout its distributional range.

2. ***Chitra indica*, Narrow-headed Softshell Turtle: EN.** Two basking individuals spotted on the sandy Brahmaputra river bank off Debeshwari and Arimora in Agoratoli and Kaziranga ranges respectively during our survey. This species is reported from Kaziranga National Park and Nameri National Park of Assam by Bhupathy *et al.* (1999). Choudhury (1995) reported it from Dibru-Saikhowa National Park. However, the species is often seen in the temple tanks of Assam. Two individuals in the possession of Assam State Zoo are reported to be from the River Brahmaputra. Another individual was rescued from Puthimari River at Puthimari Village in Kamrup District of Assam. This indicates that *C. indica* has a wider distribution in the Brahmaputra River System. Being exclusively aquatic, this species is rarely seen. Information on population is lacking. Also used to be seen commonly in local markets.
3. ***Lissemys punctata andersoni*, Indian Flapshell Turtle: Not assessed.** A single individual was observed on a log basking among the aggregation of *Pangshura sylhetensis* in Diffolu river in the park. Formerly reported by Das (1990). We also observed one shell inside the park. A highly adaptable species and can be seen in salt marshes, river, ponds, ox-bow lakes, streams, rice fields, and even in canals (Das, 1995). Used to be commonly seen in the swamps of Assam. However, of late it has become very rare in the low lying areas of the state. Extensively exploited for local trade in the state and population is pushed close to extinction.
4. ***Nilssononia gangetica*, Indian Softshell Turtle: VU.** Observed in the Debeshwari area of Brahmaputra River inside park. Juveniles in the possession of local fishermen were observed in the Bishwanath Ghat area on the north bank of the River Brahmaputra. Like other Softshell turtles, this species is also heavily exploited for meat. Even this species was earlier known to be brought from Bihar, West Bengal and Bangladesh for sale in the markets in Assam (M. F. Ahmed, unpublished data). Being exclusively aquatic, not much is known about this species. Extensive collection is the principal cause of population decline in the region.
5. ***Nilssononia hurum*, Peacock Softshell Turtle: VU.** Our observation of the species in KNP is based on juvenine individuals observed from Bishwanath Ghat area (north bank of the River Brahmaputra) and also from Kohora area. One adult individual (SCL 620 mm) rescued from local market near KNP which was reported to be caught from Diffolu river just outside park boundary. Further, in Assam State Zoo one individual was reportedly obtained from Deepor Beel Wildlife Sanctuary and two more obtained from Brahmaputra river. Das (1995) reported the species from Dilkhush, Sibsagar, Sonapur, Guijan, Nazirah, Bokakhat, Mupa-Langteng RF of Assam. Choudhury (1995) reported it from Lakhimpur and Datta (1997) reported it from Dhubri district. However, as observed by Prachag and Gemel (2002), the earlier records of this species need further verifications as some of them might represent the closely related *Nilssononia nigricans*. Known to inhabit the Brahmaputra River, its tributaries, wetlands and some of the temple ponds in Assam. Becoming rare due to population crash as extensively exploited for meat throughout the region.
6. ***Nilssononia nigricans*, Black Softshell Turtle: CR.** In the Kaziranga NP, first individual was found on April 14, 2004, at 1400 h. Observed on the bank of the Rangamatia Beel of Agoratoli Range. On 03 December 2009, one female individual (SCL 450 mm, SCW 470 mm, PL 430 mm; total CL 550 mm) was found dead near Diffolumukh camp in the Diffolu River. Another live individual (SCL 430 mm, SCW 420 mm, PL 600 mm) was observed on the bank of Sapekhati beel near Gandermari camp on 06 December 2009. The largest of the individuals in the park was observed on 18 February 2010 on the dry bed of Bhengrai Nala (1.5 km from Rongamotia Camp. This large (SCL 580 mm, SCW 480 mm, PL 570 mm, PW 540 mm; total CL 740 mm) male

was first observed on a small pool in the *nallah* on 13 February 2010 that was on the move in search of deeper water downstream.

Once thought to be restricted to the Bostami tank of Bangladesh, Prachag and Gemel (2002) reported the wild population from Bishwanath Ghat, Dibrugarh, Tinsukia and Nameri National Park of Assam and also found that *N. nigricans* is the most common turtle species found in some temple ponds of Assam which were previously misidentified as *N. hurum*. Significantly, this study recorded this species for the first time from the park. It inhabits the Brahmaputra River, its tributaries, wetlands and some temple ponds in Assam plains. No information is available on population trend. This Critically Endangered species is extensively collected for meat.

7. ***Cuora amboinensis*, Malayan Box Turtle: VU.** We found one individual (SCL 230 mm) while it was crossing forest trail at Holalpath woodland during November 2008. This individual had scratch marks on its carapace that might have resulted from a carnivore attack. Basking individuals were observed from Diffolu River and Ahotguri camp area in the park as well as a shell from Rajamari Camp indicating its widespread distribution in the park. Earlier the species was reported by Das (1995) from the park. It inhabits the low lying areas including small rivers, swamps, ponds and paddy fields of Assam. Liat and Das (1999) regarded this species as highly adaptable, and may be found in ponds, freshwater marshes, canal streams, mangrove swamps, plantations, rice fields and also around human habitation. Though least exploited for its meat, this species is becoming increasingly rare outside protected areas and almost extirpated from most of its range in Assam.
8. ***Cuora mouhotii*, Keeled Box Turtle: EN.** We observed two shells of the species from Borjuri village. Both the individuals were reportedly collected from adjacent Panbari reserved forest of Kaziranga National Park. The species was recorded from Dhansiri reserved forest of Karbi-Anglong district (Choudhury, 1993) and Madhupur Village of Lakhimpur district (Choudhury, 1996). Inhabits forest floor of the evergreen, semi evergreen and subtropical broadleaf forests of the region from 100-2500 m altitude. The species is however, recorded from Cachar Hills (Anderson, 1871), Mupa-Langteng Reserved forest, near Maibong and Kapali reservoir of North Cachar Hills (Das, 1995), Barail Wildlife Sanctuary (Das *et al.*, 2009), Garo and Khasi Hills of Meghalaya (Das, 1995), Namdhapa National Park (Deban) (Das, 1990), Mehao Wildlife Sanctuary (Bhupathy and Choudhury, 1992). The lone live individual (SCL 175 mm, PL 158 mm) encountered in the Namdhapha National Park was found on thick leaf litter of evergreen forest (M F Ahmed, pers. obs.). Das (1995) mentioned that the species presumably live in the leaf litter on the forest floor. Exploitation is uncommon because the species is extremely rare. The volume of collection by local communities is not quantified.
9. ***Cyclemys gemeli*, Indian Leaf Turtle.** Not assessed. Choudhury (2004) reported *C. oldhamii* from Baghsar Reserve Forest close to the park. Not encountered during this study. However, recently the *C. oldhamii* population found to occur in the northeast India has been recognized as a distinct species, named *C. gemeli* (Fritz *et al.*, 2008). Further, based on extended description and locality information of *C. gemeli* by Prachag *et al.* (2009) we consider that the record of *C. oldhamii* from Kaziranga can be referred to *C. gemeli*. *C. gemeli* is also recorded from Barail Wildlife Sanctuary (Das *et al.*, 2009), Nameri NP, Damra village near Goalpara; Barnihat, Meghalaya; Dimapur and Tuli village, Nagaland (Praschag, 2009).

Habitat of the species is reported as large rivers as Jia Bhoroli River and its oxbow lakes, fast flowing creeks, and also leaf litter of evergreen forest (Praschag, 2009; Das *et al.*, 2009). Loss of habitat is the major threat. Fishing with poison might be one big concern around its type locality that would need further investigation. Not much is known about the population in the region.

10. ***Geoclemys hamiltonii*, Spotted Pond Turtle: VU.** One of the frequently encountered species inside the park. The species was mainly observed in beels and swamps and also while crossing forest trails near such places. Basking individuals were observed along beels and on fallen logs of slow flowing Diffolu River.

When disturbed, individuals rapidly try to burry themselves under the mud. Previously reported by Das (1995). Das (1990) reported consumption of large individuals of this species inside the park which was also observed during this study in a few camps. Most consumed measured around SCL 250-400 mm. Though relatively common inside the park, this species is however, almost extirpated outside protected areas of Assam.

11. ***Hardella thurjii*, Crowned River Turtle. VU.** The individuals of the species were recorded from Donga, Borbeel Nulla and Mihi beel of the Park. Large shells (SCL 400-500 mm) were observed in Arimora camp was reportedly collected from large wetlands nearby. One shell at the Kohora Range Office labeled as *Kachuga kachuga* was reidentified as *Hardella thurjii* during our study. All the individuals were recorded basking on the aquatic edges of stagnant water bodies. Das (1995) also recorded this species from the park. Elsewhere, this species was recorded from Deepar Beel Wildlife Sanctuary; Mayeng Hill reserved Forest, Pabitora Wildlife Sanctuary by Sengupta *et al.* (1998, 2001).
12. ***Pangshura smithii*, Brown Roofed Turtle. NT.** Two Individuals (SCL 115 and 128 mm) in the possession of local fishermen were observed at Bishwanath Ghat on north bank of the River Brahmaputra. Both individuals were reportedly caught from river by fishermen. Das (1995) reported it from the KNP. Choudhury *et al.* (1999) reported its occurrence in both lentic and lotic environments of Kamrup district of Assam. Inhabits small and large rivers preferably in areas with abundant macrophytic growth (Frazier, 1992; Das, 1995). Though not a very common species, we observed it being released at templeponds (e.g. at Nagshankar and Hajo) in Assam by religious groups.
13. ***Pangshura sylhetensis*, Assam Roofed Turtle. EN.** Most commonly seen in the slow flowing Diffolu River of the park as they bask in congregation, on fallen logs. We also observed it in the River Brahmaputra (Arimora) and at Biswanath Ghat on north bank of the Brahmaputra. Not common in the main channel of the River Brahmaputra. Lahkar (2000) reported it from a Beel in the park. Recently, this species was also recorded from Buhridihing River, Jeypore Forest in eastern Assam (M. F. Ahmed, pers. obs.). Inhabits slow flowing rivers and streams in rocky or forested lower hills. Not much is known and surveys are targetting the species.
14. ***Pangshura tecta*, Indian Roofed Turtle. Not assessed.** We observed the species in the Brahmaputra River (within Kaziranga NP) basking on logs, aquatic vegetation or on the banks of wetlands or rivers. Previously reported by Das (1995). We observed individuals basking on *Eichhornia* sp. of the wetland near Baruntika Beel. One individual was observed and photographed while basking on a log at Diffolu River and another shell was observed on the bank of Borbeel, Arimora. Inhabits rivers as well as beels in Assam. Choudhury (1999) reported most individuals of the species from beels with reed beds. Though common in the park, this species (including *P. tentoria*) is equally rare outside the protected area as they avoid human disturbances and interferences in their habitat. Exploitation for meat or pet trade is uncommon in Assam.
15. ***Pangshura tentoria*, Indian Tent Turtle. Not assessed.** Seems uncommon but likely wide-spread over the park. We observed only few occasions at Boruntika locality, Brahmaputra River and Ahatguri (Agoratoli) area in the park. Previously reported from the park by Das (1995). Basking individuals on logs were observed in the Brahmaputra river near Agoratoli range. Choudhury (1999) reported this species as fairly common in Kamrup district of Assam. Exploitation for meat or pet trade is uncommon in Assam.
16. ***Melanochelys tricarinata*, Tricarinate Turtle. VU.** Das (1995) reported this species from the park. Live male individual (SCL 182 mm, SCW 120 mm, PL 156 mm) of the species was found while it was crossing a forest trail near Mihimukh grassland at around 1600 h. Few burnt shells were obtained from Debeshwari, Mihimukh area of the park suggesting its vulnerability from grassland burning. One shell was observed on bank of the River Brahmaputra near Mou Chapori, Buhrapahar Range. The species is also reported from Pabitora Wildlife Sanctuary (Sengupta *et al.*, 1998), Orang National Park, Kaziranga National Park, Mupa-

Lanteng Reserved Forest (Bhupathy *et al.*, 1992), Manas Tiger Reserve (Das, 1990), Sonapur and Bishwanath plain (Das, 1995). Inhabit grassland and forest areas in terai as well as in alluvial floodplains. Collected for consumption but not recorded in local trade. Nearly extirpated outside protected areas in Assam.

17. *Morenia petersi*, Indian Eyed Turtle. VU. Choudhury (2004) reported this species from the park without any specific locality. We did not encounter any live animal or shell in and around the park but most likely to be found in the wetlands of the park. Elsewhere, we observed live individuals from Deepor Beel Wildlife Sanctuary in Kamrup district of Assam and Sengupta *et al.* (1998) reported it from Pabitora Wildlife Sanctuary. Das (1995) reported from North of Brahmaputra (Assam) without giving any specific locality record. Inhabit both standing and slow moving water. Status not known.

Discussion

The diversity and abundance of freshwater turtle species in the KNP perhaps suggests that this protected area is the most important turtle habitat left in the entire Northeast India. Out of 20 recorded species from Assam state, as many as 17 species have been recorded from in and around the park. This study confirms the presence of 14 species *viz.* *Lissemys punctata*, *Nilssonia nigricans*, *Nilssonia gangetica*, *Nilssonia hurum*, *Chitra Indica*, *Hardella thurjii*, *Pangshura sylhetensis*, *Pangshura tecta*, *Pangshura tentoria*, *Pangshura smithii*, *Cuora amboinensis*, *Cuora mouhotii*, *Melanochelys tricarinata* and *Geoclemys hamiltonii* from in and around Kaziranga National Park. Occurrence of *Morenia petersi*, *Manouria emys* and *Cyclemys gemeli* in the park is based on literature records. *Pangshura sylhetensis* appears to be the most frequently encountered turtle species having patchy distribution in the Park, followed by *Geoclemys hamiltonii*, with rather widespread distribution in the park.

Out of these 17 species of chelonians recorded from park, 14 species are globally threatened. This includes one Critically Endangered (CR), six Endangered (EN) and seven Vulnerable (VU) species. Significantly, all the four species of large Softshell turtles (*Nilssonia gangetica*, *N. hurum*, *N. nigricans* and *Chitra indica*) known from eastern India are found in the park and adjoining Brahmaputra River.

The record of poorly known *Cuora mouhotii* from adjacent Panbari RF is noteworthy. This rare turtle species is seldom recorded from evergreen and semi-evergreen habitats of Northeast India. Further surveys may thus yield information on its distribution from Kaziranga-Karbi Anglong landscape. Similarly, the relative abundance of *Hardella thurjii* in the beels and stagnant waterpool of the park presumably indicate towards a significant population of this large hardshelled species in KNP.

The record of *Nilssonia nigricans* and *Cuora mouhotii* therefore constitutes the first from this area. Further, the population of the Critically Endangered, *Nilssonia nigricans* found in the park is the only known population inside a protected area. The study observed that the population of the chelonians outside the park is very thin or non existent as habitat is altered or disturbed and often individuals are killed for meat. High species richness of chelonians indicates that the Kaziranga NP offers tremendous opportunities for survival of these threatened as well as other species of tortoises and freshwater turtles.

Research, Management needs and Conservation

There is no information on community ecology of the freshwater turtles found in the park. Information on ecological requirements of the turtles are also lacking in the park that limit management options for freshwater turtles for the managers and policy makers. Further, preliminary observation suggest that grassland burning for habitat management has adverse effects on turtle species, particularly, those that remain out of water during winter. We observed that *Pangshura tecta* (n=2), *Melanochelys tricarinata* (n=6), *Cuora amboinensis* (n=3) and *Geoclemys hamiltonii* (n=1) were killed or burnt in Kaziranga or similar grassland habitats in the region. A detailed study on effect of burning on grassland and its biodiversity is of utmost need.

The turtles inside the park are well protected, however, because of fishing activity on the boundary of the park, particularly in the river sketch of Bishwanath Ghat, turtles often get entangled in the fishing nets. Also, many

juveniles and hatchlings were caught and kept for sale by the fisherman around Bishwanath Ghat, which is a serious cause of concern.

The Kaziranga National Park offers tremendous conservation opportunities for the chelonian community of the alluvial floodplains which are not found in any other similar habitats in the region. However, there is very little or no chance for chelonians of the park to get an opportunity to exchange genes with other remnant populations in the region except for a few species living in the Brahmaputra River. For long term conservation of chelonians in the region, they must be protected from excessive hunting for meat and more areas should be brought under protected area network. Also being a home to a remarkable chelonian diversity, the Kaziranga National Park represents one of the best sites for future chelonian community ecology study and wild gene pool conservation of chelonians in the region.

The level of awareness about the need of conservation of chelonians is extremely low in the region. The situation is the same around Kaziranga NP as well. Turtles are traditionally consumed in Assam and hence the turtle population outside protected areas is mostly extirpated. We have attempted to create awareness among common people and fishermen during the study including those forest staff through personal meeting and consultation. Large scale and well designed awareness activities are the need of the hour to enhance protection and conservation of chelonians in the region.

Concluding Remarks

1. The Kaziranga National Park in Assam is the only protected area that is known to house highest diversity of chelonian fauna in northeast India.
2. This study observed killing of Softshell turtles in local trade on the northern boundary of the park (Bishwanath Ghat). Earlier, Prachag and Gemel (2002) also reported turtles being sold in the markets around Kaziranga NP.
3. Including the Brahmaputra River (the 6th Addition to the park) inside the park boundary and enhancing protection measure could provide safer sanctuary to the turtles living that stretch of the river as killing for trade would be minimized.
4. The park could be a hub for turtle research in the region due to its species richness and its role in the river ecosystem.
5. Thousands of visitors around the region visit the park annually, so, a well designed education programme could spread message for turtle conservation to the mass.
6. A tortoise and freshwater turtle research and conservation facility near the park would fulfill both the purpose of research and education. We highly recommend such a move.
7. Though open sale of turtles in Assam were drastically reduced due to awareness among civil society members, NGOs and forest and law enforcement agencies, a new trend of 'home delivery' and 'supply against advance order' of turtle meat is serious concern.

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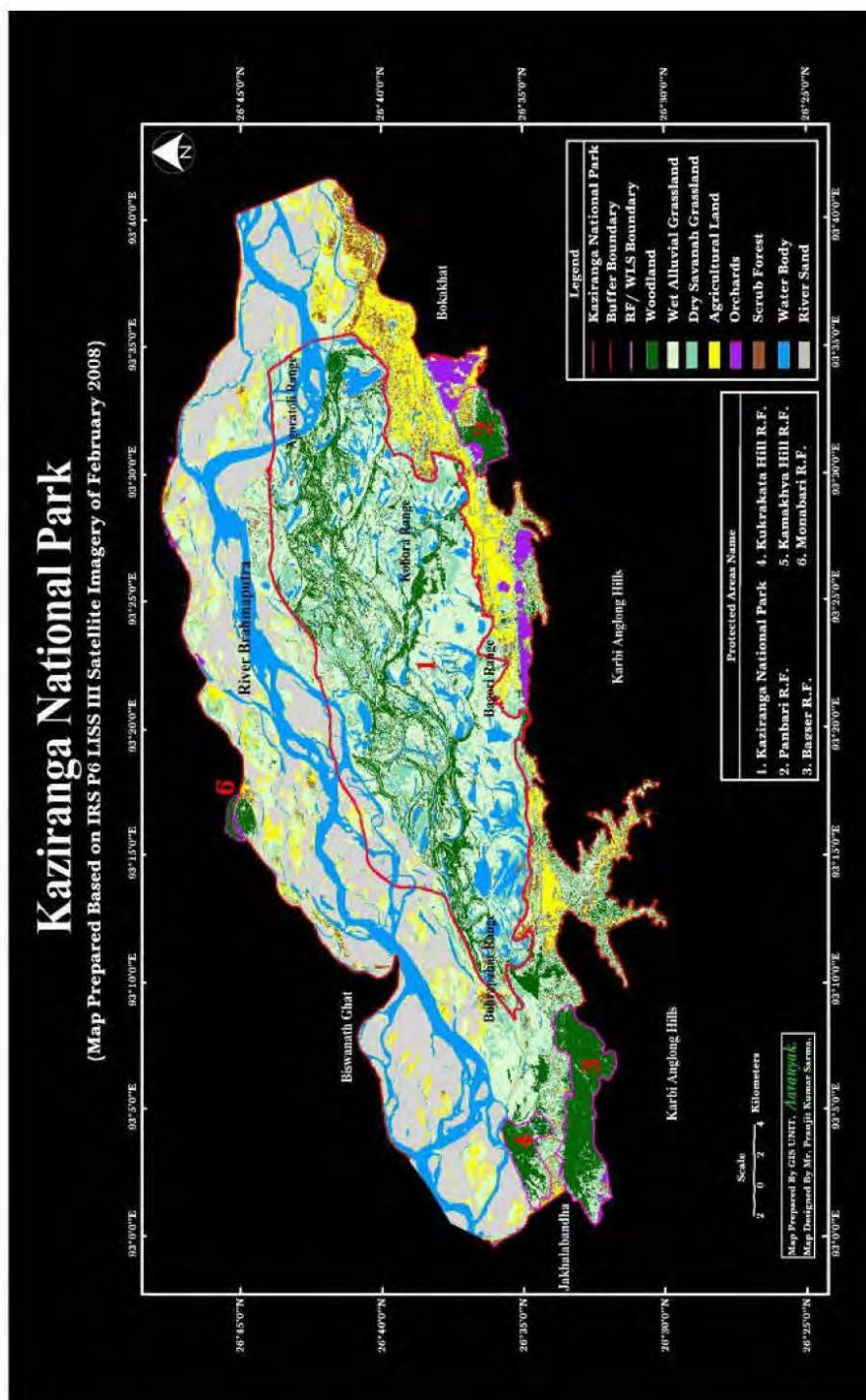
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Plate 7.1



Map of Kaziranga National Park, Assam

Plate 7.2



(A)



(B)



(C)



(D)



(E)



(F)



(G)



(H)

(A): *Manouria emys*; (B): *Chitra indica*; (C): *Lissemys punctata andersonii*; (D): *Nilssoniana gangetica*; (E): *Nilssoniana hurum*; (F): *Nilssoniana nigricans*; (G): *Cuora amboinensis* and (H): *Cuora mouhotii*. Photos A, B, C, D, F & H by M. Firoz Ahmed; E by Abhijit Das and G by Nabha

Plate 7.3



(A)



(B)



(C)



(D)



(E)



(F)



(G)



(H)



(I)

(A): *Cyclemys gemeli*; (B): *Geoclemys hamiltonii*; (C): *Hardella thurjii*; (D): *Pangshura smithii*; (E): *Pangshura sylhetensis*; (F): *Pangshura tecta*; (G): *Pangshura tentoria*; (H): *Melanochelys tricarinata* and (I): *Morenia petersi*. Photos A & G by Abhijit Das; B by Bibhuti P. Lahkar; C, D, E, F, H & I by M. Firoz Ahmed.

Turtle and Tortoise Diversity Database of Northeast India

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The Centre for Wildlife Research and Conservation Action (CWRCA) and Bioinformatics Centre (DBT-BIF), Gauhati University have developed software for exploring the Turtle and Tortoise diversity of Northeast India. A Scientific communication was made in the recent issue of *Turtle and Tortoise Newsletter* announcing this (Baruah and Sharma 2009). This software is designed to further the understanding of status, distribution and molecular phylogenetics. It will be of value in determining taxonomic relationships among turtle species and fulfill the need for identification and enforcement of protection. The database is designed with information on the turtles of Northeast India, which comprises of information based on first hand investigation, from various researchers in the region and existing literature.

The major aims of the database are:

- (i) to generate a rich source of information from behavior to molecule for the turtles of Northeast India by creating a Data Bank,
- (ii) to provide necessary information for the conservation of different turtle species of Northeast India and
- (iii) to educate the local people and budding conservationists regarding the Chelonian resources of the Northeast region.

The database is freely available for academic users. Although at present it is available in the form of CD-ROM the online version is being developed. The "Turtles and tortoises diversity information system of Northeast India" is designed to address all the conservation needs.



Database query search page with options for facilitating easy searching.
[Photo: Chittaranjan Baruah]

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Chapter 08

Fresh water Turtles and Tortoises of Orissa

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Introduction

Orissa, situated in the Eastern border of India, is located between the parallels of 17°49'N and 22° 34'N latitudes and meridians of 81° 27'E and 87° 29'E longitudes. The state is bounded by the Bay of Bengal on the east, West Bengal in north, Jharkhand and Chhattisgarh on the west and Andhra Pradesh on the south with a coastline of 482 km. Physiographically the state can be divided into three broad regions, such as, the coastal plains, the middle mountainous ranges and the rolling uplands (Sinha, 1971). The coastal region is the combination of several deltas of varied sizes and shapes formed by the major rivers of Orissa, such as the Subarnarekha, the Budhabalanga, the Baitarani, the Brahmani, the Mahanadi, and the Rushikulya. The mountainous region covers about three-fourth of the state and can be broadly divided into two groups; the Similipal massif and the Eastern Ghats. The rest of Orissa comprises plateaus and rolling uplands at the west of Eastern Ghats, which are 150-300m in elevation and flat in nature. Due to abundant perennial supplies of fresh water, the state has many reservoirs, lakes, rivers and streams, which serve as ideal habitats for fresh water turtles (Plate 8.2 E). The rivers which flow through Orissa in to Bay of Bengal can be divided broadly into four groups based on sources, such as, rivers having source outside the State (the Subarnarekha, the Brahmani and the Mahanadi); rivers having a source inside the State (the Budhabalanga, the Baitarani, the Salandi, and the Rushikulya); rivers having a source inside Orissa but flow through other states (the Bahudu, the Vansadhara, and the Nagavali) and rivers having a source inside Orissa, but tributary to rivers flowing through other states (the Machkund, the Sileru, the Kolab, and the Indravati). Apart from these, there are a few big reservoirs like Hirakud, Balimela, Indravati and many small to medium dams like Rengali over Brahmani, Naraj over Mahanadi, Mahindra over Sankh etc. in the state, serving as potential turtle habitats. Orissa also has one fresh water lake, Ansupa and a brackish water lagoon Chilka. Nevertheless, many species of turtles are also inhabitant of forests, hill streams and stagnant water bodies like ponds and ditches.

The chelonian fauna of Orissa comprises 17 species, four marine, eleven fresh water turtles and two land tortoises. Documentation of fresh water turtles, specifically in Orissa, dates back to Annandale (1907), where he mentioned about *Emyda vitata* Peters (= *Lissemys punctata granosa*) from Gopakuda Island of Chilika lake. Subsequently, Annandale (1912) in his work on turtles from river Mahanadi and tributaries reported four species including a new subspecies, *Trionyx gangeticus mahanaddicus*, which was later synonymised by Smith (1931). He also recorded *Nilssonina leithii* from Mahanadi river. Biswas *et al.* (1978) mentioned about two specimens of *Indotestudo elongata* collected from Puri and Similipal. Vijaya (1982) reported *Peleochelys bibroni* and *Batagur baska* from the river mouth at Gahirmatha coast of Bhitarkanika Wildlife Sanctuary. Moreover, in the herpetofaunal checklist provided by Dutta and Acharjyo (1990, 1993 and 1997) they reported four species of marine, ten species of fresh water turtles and two species of tortoises from Orissa. From Bhitarkanika wildlife sanctuary Chadha and Kar (1999) reported ten species of turtles including three marine species and mentioned the nesting sites of *Peleochelys bibroni* in the sandpit at Ekakula in the estuary side. Natural history information on *Nilssonina gangetica*, *N. leithii* and *Pangshura tentoria* was provided by Biswas and Acharjyo (1984a) based on the animals collected from different parts of Orissa and brought to Nandankanan Biological Park. Study on captive population of *Geochelone elegans* in Orissa was carried out by Biswas and Acharjyo (1984b). On the ecological aspects, Singh (1985) worked on terrestrial activity of *Pangshura tentoria* in river Mahanadi. Dutta (1990) provided an overview of ecology, natural history and conservation of herpetofauna of the state and raised the concern for conservation of some of the fresh water turtles of Orissa. Recently, Dutta *et al.* (2009) reported four species of hard-shell fresh water turtles, one species of tortoise and one species of soft-shell fresh water turtle from Similipal Biosphere Reserve. The authors reported *Melanochelys tricarinata* from Similipal, which was first

report from Orissa and provided notes on habitat, natural history and distribution of the species occurring in the Biosphere reserve.

However, in comparison to the enormous amount of research carried out on marine turtles, the less glamorous but not less important fresh water turtles of the state have not attracted the attention they deserve. The current study provides updated checklist of the fresh water turtles and tortoises of Orissa with their distribution and natural history information.

Methodology

The study was carried out during May 2004 till June 2009 with the aim to record the distribution and conservation status of fresh water turtle and tortoise species in Orissa. Field surveys were carried out randomly throughout the state and at selected observation points in the Mahanadi River and its distributaries of Kathjodi, Devi, Kandala, Paika, Chitrotpala and Luna rivers. In some forested areas day and night surveys were carried out to find out turtle species. Hideouts like bushes, leaf litters, gaps in large rock boulders and gaps in roots of large trees were searched for hiding or hibernating turtles or tortoises. Hill stream beds and river banks were surveyed to search for turtle tracks, following which sometimes yields the specimens. Besides, the fishermen and local communities were interviewed and the fresh water turtle species were identified from the by catch of fishermen. Sporadic records of seizure of turtles and market survey were conducted during the study period to assess the threat to some of the species due to trading. Basking turtles were spotted from a distance by binoculars from boat or by walking along the bank. Species identification was done following Das (2002). Dead turtle specimens and turtle carapace were identified following Smith (1931).

Systematic account of Fresh water turtle and tortoise species of Orissa

Order: Chelonia

Family: Bataguridae

***Batagur baska* (Gray, 1831):** An estuarine species living mostly in shallow, muddy tidal regions at river mouths lined with mangroves or other vegetation. In Orissa, this species is reported only from the estuaries of Bhitarkanika wildlife sanctuary. Das (2002) and Chadha and Kar (1999) provided some account on natural history of the species. Though this species is believed to be extinct from Orissa but latest reports from local fishermen of Kendrapada district indicate that a population might inhabit the estuarine areas of the Mahanadi delta. Fishermen also report that they were abundant about a decade ago.

***Pangshura tecta* (Gray, 1831) (Plate 8.1 A):** This species was reported from up-stream rivers away from the mangrove swamps in the fringe areas of Bhitarkanika wildlife sanctuary (Chadha and Kar, 1999). It is also found in down streams of Mahanadi river at Munduli, Kakhadi, Cuttack and also in some places of Kathajodi river. This species is most common in the northern part the state in Balasore and Mayurbhanj districts and is reported from Subarnarekha, Budhabalanga, Deo, Salandi and Palpala rivers (Dutta *et al.*, 2009.). It is also an inhabitant of ponds in Balasore and Mayurbhanj districts and lives in sympatric with *Lissemys punctata*. A clutch of 1-6 eggs are laid during the winter months in sandy or muddy banks of the water bodies.

***Pangshura tentoria* (Gray, 1834) (Plate 8.1 B):** This species is represented by the subspecies *P. tentoria tentoria* (Gray, 1834) in Orissa. It is found throughout Mahanadi, Brahmani, Baitarani, Budhabalanga, Subarnarekha and Tel rivers. This species is the most common by-catch during fishing activities in river Mahanadi and of late there is a nascent demand for its shells for the poultry feed industry. We have found local trappers being induced by traders to catch such turtles, which are otherwise inedible. Nesting takes place during the months of November to January in the sandy river banks. In ponds and marsh lands the species is seen to nest on the mud bank. A clutch of 1-10 eggs are laid by digging nearly 300 mm pit. The eggs are consumed by the people and other predators like dogs and Jackals.

***Melanochelys trijuga* (Schweigger, 1812) (Plate 8.1 C):** This species is represented by the subspecies *Melanochelys trijuga indopeninsularis* (Annandale, 1913). It is a forest dwelling species living in dry deciduous, moist deciduous and semi evergreen forests near water bodies or swampy grasslands. Das and Bhupathy (2009) showed the distribution of the species only in Northern Orissa. During this study we recorded the species from Similipal Biosphere Reserve, Mayurbhanj district; Ranapur, Nayagarh district; Kapilas, Dhenkanal district; Daringbadi, Boudh district; Mahendragiri, Parelakhemundi and forested areas of Rayagada district. Breeding takes place during monsoon season and egg lying was observed during November. A clutch of 8 eggs was recorded from

a female of carapace length 330 mm in captivity. It is omnivorous and readily takes vegetables, prawns and snails (*Acatina fulica*) in captivity (*pers. obs.*).

***Melanochelys tricarinata* (Blyth, 1856) (Plate 8.1 D):** The species was earlier reported from Chainbasa of Jharkhand district (Blyth, 1856). Das (2009) recorded the distribution of the species in a relatively narrow sub-Himalayan belt. Dutta *et al.*, (2009) reported a large population from the swampy grassland and meadows of Upper Barhakamuda in the Similipal Biosphere Reserve. Recently, a specimen was found in Ranapur forest of Nayagarh district extending its range in Eastern Ghats of Orissa. It is mostly active during night time; captive individuals feed on vegetables, wild fruits, different species of snails and crabs.

Family: Testudinidae

***Geochelone elegans* (Schoepff, 1795) (Plate 8.1 E):** This species is found in dry and arid zones of Eastern Ghats, south of river Mahanadi. It is reported from Ganjam district and in the hills of Parelakhemundi and Gajapati. This species is found in the *Casuarina* and Cashew plantation along the coast, in scrub forest and dry deciduous forest. In captivity, breeding females were reported of more than 210 mm carapace length and breeding activity was from October to January (Biswas and Acharjyo, 1984; Smith, 1931). Four to six eggs were laid, slightly oval in shape, measuring 37 X 41mm to 21.3 X 24.5mm. The incubation period is 122 days (Dutta: *pers. obs.*)

***Indotestudo elongata* (Blyth, 1853) (Plate 8.1 F):** This forest dwelling species mostly found in Sal dominated moist deciduous and semi-ever-green forests with big rock boulders. It was reported from throughout Similipal Biosphere Reserve of Mayurbhanj and Keonjhar districts; Kuldiha of Balasore district; Hadgarh of Keonjhar district, Kapilas hill ranges of Dhenkanal district and Baialishmauja of Cuttack district (Dutta *et al.*, 2009).

Family: Trionychidae

***Nilssonia gangetica* (Cuvier, 1825) (Plate 8.1 G and H):** This species is found in most of the rivers and reservoirs in Orissa, specifically in the Mahanadi, Ramiala, Tel, Brahmani, Baitarani, Budhabalanga, Devi, Chitrotpala rivers; Chilka lake, Hirakud, Indravati and Balimela reservoirs. Nesting takes place during winter and hatchlings were seen during monsoon period. This species nests in the sandy bank and also in sandy loam soils near ponds and other water-bodies. A clutch of 30-85 round eggs are laid by digging a deep pit. This species is worshiped in many of the temple ponds in Orissa. It is omnivorous in feeding habit and individuals were seen feeding on cattle or even human carcasses near the river banks. It is mostly exploited for meat and medicinal value of the calipee.

***Nilssonia hurum* (Gray, 1831) (Plate 8.1 I and 8.2 A):** This species is found in Mahanadi river, specifically at Satkosia gorge, Kantilo and Naraj area having deep water and also reported from Nemala area of Chitrotpala river and up streams of Brahmani, Baitarani and Dhamra rivers near Bhitarkanika wildlife sanctuary. The juveniles of the species are worshiped due to the prominent eye-spots resembling the eyes of Lord Jagannath.

***Nilssonia leithii* (Gray, 1872):** This species is mostly confined to Southern Orissa. Biswas and Acharjyo (1984) mentioned that two females were collected from Balimela reservoir in Sileru river at Chitrakonda in Koraput district (now Malkanagiri). However, our surveys in Mahanadi river did not yield any sightings.

***Pelochelys cantorii* Gray, 1864:** The earlier records of *Pelochelys bibroni* (Owen, 1853) from Orissa by Vijaya, 1982; Das (1987) and Chadha and Kar (1999) are now referred as *P. cantorii* Gray, 1864 (Webb, 1997; Das, 2008). This species is known from estuaries and sea coasts in Orissa. Das (1987) mentioned about distribution of the species in Brahmani-Baitarani delta at Bhitarkanika wildlife sanctuary, where it is reported to be nesting. Chadha and Kar (1999) reported this species in Patasala area of Brahmani, Baitarani, Dhamra and Kharasrota rivers. Unconfirmed reports are from Chitrotpala and Luna rivers in Kendrapara district (fishermen reports). Although it is considered rare in many parts of Indian subcontinent, this species is not uncommon in Bhitarkanika (Chadha and Kar, 1999).

***Chitra indica* (Gray, 1831) (Plate 8.2 B):** A purely freshwater species living in deep water gorges and can reach up to 70 kg body weight. The dorsum carries a striking pattern of deep yellow and black closely resembling the colour pattern of tiger, as a result of which many locals describe it as "tiger turtle". This study reports the species from Mahanadi river at Satkosia gorge, Kantilo, Kandarpur, Munduli area having water depth of more than 40 feet. Several specimens were caught by fishermen and released. It is highly aggressive in disposition



and prefers steep river banks for basking. A clutch of 25-60 eggs are laid during winter months near the sandy bank. Eggs are sometimes predated by people, dogs and jackals.

***Lissemys punctata* (Lacepede, 1788) (Plate 8.2 C and D):** One of the most common fresh water turtle species in the state. This species is known to live in rivers, ponds, low-land agricultural fields and swampy areas. It occurs throughout the rivers and ponds in Orissa. Annandale (1907) reported the subspecies *Lissemys punctata granosa* [synonymised as *L. punctata punctata* (see Fritz and Havens, 2007)] from Chilka lake, which has also been recorded from many parts of south Orissa (Sanyal, 1993). This species is widely poached for the fresh water turtle trade in Orissa and regular consignments are sent out from the coastal areas of Pipili, Rahama, Jajpur, Niali, Paradip and Jagatsinghpur to West Bengal.

Conservation of Fresh water turtles in Orissa

Though turtles are worshiped as incarnation of Lord Vishnu in Hindu culture, still they face threats due to habitat destruction and a steadily growing market for turtle meat, eggs and pet trade. Out of the 17 species of turtles found in Orissa, all the four species of marine turtles and seven species of freshwater turtles are listed under Schedule-I of Wildlife (Protection) Act, 1972. Four species are listed under Schedule-IV and two species are not listed. Threats to individual species and the legal protection status are summarized in Table-1.

Community conservation efforts

Many of the large fresh water turtle species are protected by the cultural and religious systems of the local community belief. *Nilssonia gangetica* is protected by the local community in Champeswar Temple near Baramba and in Maneswar temple of Sambalpur (*Surakshya se Samrakshyan*, Vasundhara, 2007). In Parelakhemundi many temples also serve as rescue centres for species like *Geochelone elegans*. When people find turtles in their agricultural fields during forest fires, they bring them to the temples and later release them into the wild after a few months. In some of the areas along the Mahanadi river and its distributaries from the stretch from Gania to Paradeep, where there were reports of rampant poaching and trade, the local communities are now protecting the turtles after the initiative taken by the Wildlife Society of Orissa, a non Government Organization based at Cuttack.

Suggested conservation measures

1. A detail inventory of fresh water turtles inhabiting the river systems of Orissa and their current status is in urgent need to address the conservation measures of the group.
2. Developmental activities and destruction of turtle nesting sites due to rampant sand mines should be stopped or regulated to give protection to the species.
3. Study should be carried out to examine the possible threats to the turtle species due to habitat loss, forest fire and poaching.
4. Steps to be taken to stamp out the ongoing fresh water turtle trade.
5. Creating awareness programmes in villages and schools to curb illegal trade of turtles and their parts will be helpful.
6. Community conservation efforts should be properly recognized, loss of fishing nets should be compensated and management guidelines can be developed for better management of the turtles.

Research Gap: Random surveys carried out in the various turtle habitats (except that of Mahanadi river system) were not done throughout the year. We could not cover the Mahandi river system completely; important tributaries flowing in the state of Chattisgarh were omitted from the survey due to limited funding support. Major tributaries like Ong, Ib and Tel in Orissa were not covered. Distributaries like Bhargavi, Birupa, Genguti, Nuanai, Kuakhai and Kushabadra were not surveyed.

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Table-1: Annotated checklist of fresh water turtles and tortoises of Orissa with their protection status and threats to individual species

S.No	Scientific name	Vernacular name	Legal protection	IUCN	CITIES	Threats
1	<i>Batagur baska</i>	Hadua nadi kaincha/ Ram Kachim	Schedule I	Critically Endangered	Appendix I	Fishing activities, trapping for the trade
2	<i>Pangshura tecta</i>	Nali-baka katha kaincha	Schedule-I	Lower Risk/least concern	Appendix-I	Incidental by-catch in fishing; eggs are predated by jackals, dogs and human; habitat destruction due to sand mining
3	<i>Pangshura tentoria</i>	Katha kaincha	Not listed	Lower Risk/least concern	Appendix-II	Incidental by-catch in fishing; eggs are predated by jackals, dogs and human; habitat destruction due to sand mining
4	<i>Melanochelys trijuga</i>	Kala pahadi kaincha	Not listed	Lower Risk/near threatened	Not listed	Forest fire; live pet trade for medicinal value of meat and shell, use of shells for violin like musical instrument.
5	<i>Melanochelys tricarinata</i>	Tini-garia pahadi kaincha	Schedule-I	Vulnerable	Appendix-I	Forest fire, habitat destruction.
6	<i>Geochelone elegans</i>	Star kaincha	Schedule IV	Lower Risk/least concern	Appendix II	Strong demand for pet trade, being exported in large numbers, trading of shells for decoration.
7	<i>Indotestudo elongata</i>	Pathuria kaincha	Schedule-IV	Endangered	Appendix II	Pet trade, local food, use of shells for violin like musical instrument
8	<i>Nilssonina gangetica</i>	Balera kaincha	Schedule-I	Vulnerable	Appendix I	Local consumption of meat; inter-state trading for meat; large scale trading of calipee for medicinal purpose; poaching of eggs; habitat destruction due to sand mining.
9	<i>Nilssonina hurum</i>	Chata kaincha	Schedule-I	Vulnerable	Appendix I	Local consumption of meat; inter-state trading for meat; large scale trading of calipee for medicinal purpose; poaching of eggs; habitat destruction due to sand mines.
10	<i>Nilssonina leithii</i>	Not available	Schedule IV	Vulnerable	Appendix II	Probably killed for meat and for medicinal value of calipee.
11	<i>Pelochelys cantorii</i>	Not available	Schedule-I	Vulnerable	Appendix II	Fishing activities
12	<i>Chitra indica</i>	Chitra kaincha, Tiger kaincha	Schedule-IV	Endangered	Appendix II	Local consumption of meat; inter-state trading for meat; poaching of eggs; habitat destruction due to sand mining.
13	<i>Lissemys punctata</i>	Pankua kaincha, Thali kaincha	Schedule-I	Lower Risk/least concern	Appendix II	Local consumption and inter-state trading for meat.

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Plate 8.1



(A)



(B)



(C)



(D)



(E)



(F)



(G)



(H)



(I)

(A): *Pangshura tectum*; (B): *Pangshura tentoria*; (C): *Melanochelys trijuga indopeninsularis*; (D): *Melanochelys tricarinata*; (E): *Geochelone elegans*; (F): *Indotestudo elongata*; (G): *Nilssonia gangetica* (Juvenile); (H): *Nilssonia gangetica* (Adult) and (I) *Nilssonia hurum* (Adult)

Plate 8.2



(A)



(B)



(C)



(D)



(E)

(A): *Nilssononia hurum* (Juvenile); (B): *Chitra indica*; (C): *Lissemys punctata*; (D): *Lissemys punctata* (Albino) and (E): River system of Orissa showing major river basins
(Source: <http://www.dowrorissa.gov.in/SWFs/RiverSystem.htm>)

An Evaluation of Distribution, Status and Abundance of Freshwater Turtles in Uttar Pradesh

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Introduction

The state of Uttar Pradesh (UP) in north India, lies between 77°5'–84°38'E and 23.0°–30°24' N covering a geographical area of 240927 square kilometer or 7.33 percent of land area of the country and divided into seventy one districts (TERI 2003). The state comprised four major ecological zones namely *Terai* (foothills of Himalaya), Gangetic Plain, *Vindhyan* and Semi-arid region.

Fifteen of the twenty-nine species of fresh water turtles and tortoises found in the subcontinent occur in the state of Uttar Pradesh but virtually no base line information exists on the species wise occurrence or abundance – qualitative or quantitative - in specific habitats. Notable exceptions are the efforts of Basu 1993 (Gomti River) and 1996 (Yamuna River); Javed and Hanfee 1995 (Dudhwa National Park) and Rao 1998 (Upper Ganges River). Even if these contributions of the above workers are considered together they scarcely makes good the deficiency in information, which precludes objective evaluation of status monitoring and planning and prioritization of conservation of turtles in the state. This remains daunting task for a state with over 11,000 known wetlands. In September 2004, we initiated systematic surveys in order to assess distribution and status of turtles in the rivers and wetlands of the state. The objective of these surveys was to compile an inventory of turtle habitats in the state to enable prioritization for future detailed collection of base line information on species occurrence and abundance and facilitate the planning of high priority habitats to initiate conservation actions. Here we present observations on distribution and abundance of turtle species surveys in over 100 wetlands from 20 districts of the state and prioritize their importance as turtle habitats as assessed from 2004 through 2008.

Methods

Our work was divided into two phases. In Phase I, identified habitats were surveyed continually from September 2004 through December 2005. In Phase II, from January 2006 through December 2008, surveys were conducted more opportunistically and simultaneously along with the "Egg Protection Program for Endangered Turtles in National Chambal Sanctuary of Uttar Pradesh and Madhya Pradesh". While the number of days devoted to the surveys each year is presented as Plate 9 A.

Surveys

We visited wetlands (lentic and lotic) that reportedly were potential turtle habitats, about which information had been received through interviews and enquiries or during the surveys of other wetlands. We designed and used a 17 point "Habitat Data Sheet" (Appendix 1) to collect relevant information on the attributes of the wetland as turtle habitat and photographed the habitats. A colored turtle identification guide by Hanfee (1999) was used while interviewing local residents, fishermen and occasionally (ex-) turtle poachers of the habitat area about the occurrence and abundance of various turtle species.

Habitats were sampled for turtles by manual capture, deploying specialized turtle gears mainly hoop-traps and various traditional fishing gears especially nylon gillnets or any other gear used locally for catching turtles. Deployed traps were checked at regular intervals to avoid any accidental drowning of turtles. Incidental



catches of turtles in fishing gear of local fishermen were also examined and these together totaled nine different methods of sampling. Data on all turtles captured during sampling or dead turtles or other turtle material (primarily shells) found and examined during the surveys was recorded on a separate turtle sampling data sheet. Turtle specialized gears were minimally used in order to not to reveal local turtle trappers about new trapping techniques. The gears used during the sampling at different habitats were as follows:

A: Exclusive Methods used for sampling of turtles: 1.Hoop trap 2.Iron probe 3.Seine net 4. Drift Net 5. Manual capture

B: Types of fishing gears whose incidental captures were examined: 1.Basket trap 2.Drag net 3.Hook 4.Throw net

Sixty nine of the 101 surveyed habitats were sampled on 123 different occasions for occurrence of turtles. But turtles were captured only from 60 habitats. Turtles caught were measured, weighed, sexed on the basis of external dimorphism and selectively photographed before being released at the precise location of capture. Binoculars were used to spot turtles during visits to the habitats. Turtles were observed basking on riverbanks only during boat and foot surveys. Turtles were not accounted for when observed swimming on the surface of habitats covered with aquatic vegetation.

Prioritization of Habitats

The wetlands/habitats visited, were assigned an ascending score of 1 to 10 for each favorable criterion and a composite score calculated for the habitat to assign it a priority rank on the basis of the composite score. The habitats were then prioritized by using a matrix, which takes into consideration the following six evaluation criteria:

Habitat Extent

A score was assigned according to the extent/size of the wetland. <1 Hectare –1; 1-5 Ha –2; 5-10 Ha – 3; 10-25 Ha – 4; 25-50 Ha – 5; 50-100 Ha – 6; 100 - 250 Ha – 7; 250 -500 Ha – 8; 500 -1000 – 9; >1000 – 10; All small rivers and streams – 5; All medium and larger rivers – 7

Human Impact and Anthropogenic Factors

Activities such as fishing, sand removal, construction, siltation have severe impacts on turtle populations and nesting. (Choudhury1995). Factors like Sewage/Industrial discharge influx, Water abstraction, Water level manipulation, Fishing gear interference/mortality, other anthropogenic disturbance; distance from nearest human habitation were taken into consideration to score for this section.

Habitat Suitability

The freshwater turtles- both Batagurid (hard-shell) and Trynoid (soft-shell) need special critical habitats in aquatic as well as aquatic-terrestrial transition zone (Daniel 1983) to perform various biological activities like basking, nesting, foraging and thermoregulation. So perennality, contiguity with river or lotic habitats, maximum depth, shoreline suitability for basking and nesting, availability of forage/food, absence of predation pressure/ direct hunting of turtles, Absence of eutrophication (weed infestation) were the factors considered for rating habitat suitability.

Species Diversity

The available score (10) was divided by the number of freshwater species occurring in the state (14). The resulting score was timed with the number of species suspected or known to be extant in habitat, rounded to the nearest whole number for determination of score.

Total Population Abundance

Unknown/known Low Abundance-1, Confirmed High Abundance-10

Absent -1; Near absent -2; Unconfirmed low abundance -3; Confirmed low abundance -4; Unconfirmed Moderate abundance -5; Confirmed Moderate abundance -6; Unconfirmed high abundance -7,8; [if one or more species are believed to be abundant in the habitat] Confirmed high abundance -9, 10; [if one or more species are known to be abundant in the habitat]

Rating of High Priority Species

The habitats were rated according to the number of species of high conservation priority occurring in the habitat, in the following order of listing: *Batagur* (earlier known as *Kachuga*) *kachuga*, *B. dhongoka*, *Chitra indica* *Hardella thurjii*, *Nilssonina hurum* *N. gangetica*, *Geoclemys hamiltonii*.

Results

A total 61 wetlands from 9 districts and 40 wetlands from 11 districts were surveyed in phase I and II respectively. A map of the state of Uttar Pradesh depicting the surveyed districts is presented below as Plate 9 E. 101 wetlands in 20 districts (Pilibheet, Kheri, Bahraich, Shravasti, Hardoi, Lucknow, Barabanki, Sultanpur, Unnao, (Phase I) Gonda, Balrampur, Gorakhpur, Etawah, Sitapur, Agra, Aligarh, Faizabad, Bulandshahr, Farukhbad, Allahabad (Phase II), of the state were visited, which included the survey of a continuous section of the Gomti River spanning c. 250 km in four districts namely Hardoi, Lucknow, Barabanki and Sultanpur. An important section of the Ganges River (Avantika Devi to Ramghat) on the border between districts Bulandshahr and Badaun and in Farrukhabad district and adjacent wetlands were also surveyed in fair detail. Furthermore, entire length of Chambal (Etawah and Agra districts), Yamuna (Agra and Etawah districts), Sarju (Gonda and Bahraich Districts) and Ghaghra (Bahraich and Barabanki districts) river were repeatedly surveyed and sampled on different occasions. The habitats visited were categorized into 9 types, which are stated as follows, with the number in square parentheses indicating the number of habitats of each type visited.

A) Small river [5] B) Large river stretches [4] C) River-pool [7] D) Stream (Hindi- nullah) [6] E) Marshy-wetland [10] F) Ox-bow lake [4] G) Pond <1 Ha [38] H) Lake >1Ha [23] I) Dammed reservoir [4]. Forty percent of the ponds were always covered with dense floating or emergent aquatic vegetation and turtle sightings were insignificant and negligible at such habitats.

During the course of these visits 618 turtles belonging to 14 species (4 Trionychids and 10 Batagurids) were either captured or obtained from fishing/ turtle traps deployed by fishermen and turtle poachers and examined from 60 different sites enabling confirmation of their occurrence in the particular habitats (Plate 9C). The species that were captured/ encountered and examined during surveys were *Batagur kachuga* (9), *Batagur dhongoka* (24), *Chitra indica* (9), *Lissemys punctata andersoni* (69), *Melanochelys trijuga indopeninsularis* (7), *Melanochelys tricarinata* (4), *Pangshura tecta* (79), *P. tentoria circumdata* (112), *Pangshura smithii* (89) *Geoclemys hamiltonii* (18), *Nilssonina gangetica* (36), *Nilssonina hurum* (7), *Hardella thurjii* (143) and *Morenia petersi* (12). The result from is presented as proportion of species in entire samples with the location of occurrence in Plate 9B.

Apart from the samples of turtles documented above, we also recorded quantified data of turtles basking and swimming, which were most frequent in the Chambal River in Agra and Etawah, Ganga River in District Bulandshahr and Farrukhabad and in the Gomti River in the districts Barabanki and Sultanpur. In addition, eight ponds protected traditionally or for religious reasons were also documented. These ponds harbor considerable numbers of a few soft-shell turtle species especially *N. gangetica* and *L. punctata andersonii*. In the Gomti River the observed density of *P. tentoria circumdata* was considerable and probably comparable to those seen by other workers in the Yamuna River of the state in 1996. Out of the total habitats visited 10 habitats, listed in Table-1, of present communication, were rated as most important on the basis of the criteria mentioned and further described for each habitat in the table. These ten habitats have been selected for further intensive observations, investigations (including sampling), and conservation research and species recovery programs.

Table-1: Few Prioritized Turtle Habitats for Conservation Action Planning and Implementation.

Order of priority of habitat	Name of habitat	Criterion
1	Chambal River in Etawah and Agra (ca. 175 km)	This habitat supports fairly good populations of few endangered chelonians viz. <i>Batagur</i> , <i>Chitra</i> and <i>Hardella</i> species. Relatively undisturbed and protected habitat offers various micro-habitat complexes to different turtle species and serves as repository for breeding populations of most critically endangered turtle species of the state i.e. <i>Batagur kachuga</i> .
2	Sarju River near Colonelganj in Gonda (ca. 120 km)	The diverse habitat conditions (swampy/marshy as well as relatively clear slow flowing patches), which harbor several species of turtles <i>Hardella</i> , <i>Chitra</i> , <i>Geochelamys</i> , <i>Morenia</i> , <i>Nilssonia</i> , <i>Lissemys</i> etc. Few large breeding populations of <i>Hardella</i> located on different pools of the river recently (S. Singh, unpublished data). Some of the stretches are under socio-religious protection.
3	Gaghra river down Ghaghraghat and Bahraich (ca. 50 km)	Support fairly good population of <i>Chitra indica</i> , <i>B. dhongoka</i> and <i>Pangshura smithii</i> . Species like <i>Geochelamys hamiltoni</i> , <i>Hardella thurjii</i> and <i>Nilssonia</i> species also found in back water of the river. Although the habitat is unprotected but relatively sustaining anthropogenic pressures due to its fast flow and vast flood land (mostly unfit of human habitations)
4	Mala and Khannuat Rivers in Pilibheet (ca. 10 km and 15 km respectively)	Three streams lying within a dense reserve forest that is fairly well protected. During week long surveys in 2005, 11 turtles belonging to 6 species were captured and examined. Notables are <i>Morenia</i> and <i>Melanochelys</i> . The overall density and diversity of chelonians in the area appeared to merit further study to characterize their present status, as the turtle assemblage occurring in this habitat merit concerted conservation efforts.
5	Kakrakhera village pond, Hardoi (2 hectares)	A community protected small pond, but support high density of <i>N. gangetica</i> and <i>N. hurum</i> . The turtles receive comprehensive protection from villagers and represent a role-model of positive human-turtle wildlife relation.
6	Goolar taal, Pilibhit ((ca. 40 hectares)	A very good habitat, where population of the six species of the turtles (<i>G. hamiltonii</i> , <i>H. thurjii</i> , <i>M. petersi</i> , <i>M. tricarinata</i> , <i>L. p. andersonii</i> , <i>N. gangetica</i>) could be reported and secured in view of the undisturbed and biotic-pressure free nature of the habitat.
7	Darangha and Raja Nal Ka Taal river pools on Gomti River, Sitapur/Hardoi (ca. 40 km)	Though under immense fishing pressure and water pollution, the river offers suitable habitat for certain species of turtles favoring slow flowing habitats. There are considerable stretches that are not disturbed by anthropogenic factors where good basking and nesting sites were observed. A fairly dense assemblage of <i>P. tecta</i> and <i>P.t. circumdata</i> was captured during the mark-recapture studies by Basu (1993) and Singh (2003) respectively. The habitat supports eight more turtle species besides fairly abundant <i>Pangshura</i> .
8	Ramganga confluence, Ganga River, Farhukabad (ca. 10 km)	This river stretch recently finds a place in the top ten turtle habitats in the state after a confirmation that it serves as a communal nesting site for <i>Chitra indica</i> , an endangered soft-shell turtle species. The habitat is under biotic pressure and water pollution but the other favorable habitat attributes, considerable diversity and density of other soft shell and hard shell turtle species make it one of the possible turtle conservation reserves where threatened turtle populations can be restored in future.
9	Yamuna River (Bateshwar to Pachnada) Agra and Etawah (ca. 80 km)	Due to religious protection to the few stretches this habitat support a good density of <i>Pangshura</i> and <i>Nilssonia</i> . In addition further this stretch is strategically important for the conservation management of Chambal River in National Chambal Sanctuary. Larger river turtle species like <i>Batagur kachuga</i> , <i>B. dhongoka</i> , <i>Hardella</i> , <i>Chitra indica</i> seasonally migrate into this stretch from the protected Chambal especially during monsoon season.
10	Sharda sagar dam reservoir, Pilibhit (Over 200 hectares)	The Sharda Sagar reservoir provides extensive habitat for chelonians especially those that inhabit lentic habitats. The water of the reservoir is unpolluted. A detailed study on the ecology of turtles in such dams is required.

Discussions

Only two periods of all survey years totaling about five months per year were found, optimal for survey and sampling during the tenure of our work. The first was from early October to mid-November [end of monsoon to onset of winter] and the next from early-mid March to mid July [end of winter to onset of monsoons]. Other than these periods, habitats were either flooded or ambient temperatures were too low, as a result most species of turtles were not active enough to be observed or sampled. Nesting of few species recorded during the August (C.

indica and *N. gangetica*), November (*P. tentoria circumdata*), February and March (*B. dhongoka* and *B. kachuga* respectively), which was helpful as a direct indicator of presence of certain species in a few of the habitats.

The results of the surveys along with findings of the turtle sampling exercises and reconsideration of existing information indicate that turtle populations in the state of UP, have declined considerably and habitats have been degraded. This decline is very pronounced in the case of large Batagurids, as surviving populations of *B. kachuga*, *B. dhongoka* and *H. thurjii* were reported or captured from a few tributaries of Ganga River. The breeding population of *B. kachuga* can be confirmed only from the Chambal. In addition, few specimens were found in lesser Yamuna river (close to Yamuna- Chambal confluence) in August 2007, individuals were probably seasonal migrants from the Chambal River during the monsoon season. No specimen of *B. kachuga* was captured during extensive surveys in the upper Ganga close to Narora Dam in 2005 and 2006. Continued occurrence of *B. dhongoka* could be confirmed from Ganga, Ghaghara, Chambal, Yamuna Rivers and few other oxbow lakes in vicinity of Ganga and Ghaghra but were recorded to have disappeared from several pools of the Gomti (Singh and Basu 2003; unpublished data); where it was found just a decade before (Basu, 1993).

Soft-shells like *N. gangetica*, *N. hurum* and *C. indica* are being targeted and extensively hunted for their meet and calipee (outer cartilaginous rim) throughout the areas covered during the surveys (TCM). The rim is exported illegally to South-east Asia where it is used in the Traditional Chinese Medicine as aphrodisiacs. One kilogram dried calipee fetches about ' 2000 (\$ 50) to the turtle trappers in Terai (Singh 2008, unpublished data). Turtle trade is being operated by organized gangs mostly based in Central parts of the state like Kanpur, Sultanpur, etc.

Javed and Hanfee (1995) reported *B. dhongoka* from lentic wetlands of protected areas such as Dudhwa National Park, but they have remarked that these wetlands may represent marginal habitats for the species. *Hardella* was reported by them as common in these habitats (Plate 9D) and there is no reason to believe that the situation has altered very much. Not much additional information on the status of single tortoise species *Indotestudo elongata* of state could be gleaned in the course of the surveys conducted except a specimen found by forest department staff from the Sohelwa Wildlife Division in Balrampur in 2007 (Sanjay Pathak, pers. comm).

Species such as *Lissemys* and *Pangshura* species were ubiquitous and hold their own even in marginal habitats and in the face of considerable hunting pressure for food and pet trade respectively.

The average encounter rates for *P. tentoria circumdata* in the Gomti was 8.85 km^{-1} (+ 6.33; 1.14 – 26.0) [compared with 18.58 km^{-1} (+ 12.67; 3.8-34.8) in Lesser Yamuna (above its confluence with Chambal River)] (UPFD 1996). *P. smithii* was observed in high densities in the Ganges River in districts Bulandshahr/Badayun in western UP and *P. tecta* in the Khurdiva wetland (a backwater) in district Shravasti, a situation which is likely to be consistent through many smaller streams that occur in the extensive Ganges River System flowing through the state. Likewise among the Trionychidae, *L. punctata andersonii* is believed to be comparably abundant, as it was located or reported from almost all the habitats visited so far. The reasons for the survival success of these species may be a) in the case of *Pangshura* – these are herbivorous turtles with abundant food resources available in their habitats and because of their small size they do not suffer high mortalities in fishing nets like the larger Batagurids such as Batagur and *Hardella*. b) *Lissemys* because of its ability to aestivate by burrowing into pond and lake bed mud, is able to inhabit numerous marginal habitats that are ubiquitous throughout the state. Even though they are actively hunted by the *Kuchbadhia* (a semi-nomadic tribe of Northern India) communities and other turtle trappers for illegal export to the South-east Asia through eastern parts of the country and make up the bulk of the considerable clandestine trade in turtles, the volume of trade seems to be clearly sustainable compared to the availability of resources.



The surveys unearthed new informations in confirming the occurrence of *Morenia petersi* in the district of Pilibhit. This is a notable locality record for this species, more than a 100 km north-west of Dudhwa National Park in district Kheri where it was last recorded by Javed and Hanfee in 1995. One specimen of the species was also found in Ganga close to Kanpur town in November 2008 (S Singh unpublished data), which is the southern most locality record in the Ganges for the species which is most expectedly a *Terai* dwelling species.

Research and Conservation Management Requirements

The surveys should be continued to sample as intensely as possible all potential turtle habitat in remaining districts of the states to documenting all pockets where turtles do survive in any great diversity and/or abundance. Also systematic assessment of habitat suitability and viability should be routinely done to identify habitats where conservation based on ex-situ measures and supplementation/reintroduction may be taken up.

A recovery program is immediately warranted for endangered turtle species like *B. kachuga*, *B. dhongoka* and *C. Indica*. Turtle surveys must be initiated to understand the demand on different turtle species, the trade route and the quantities involved in the trade.

The three batagurid species *Morenia petersi*, *Melanochelys tricarinata* and *M. trijuga* indopeninsularis, which were formerly believed to occur only in the east regions of the country, was discovered in this state only within the last two decades. The distributions of these three species have not been studied but they are believed to be restricted to the moist *Terai* region that adjoins the Himalayas. However the limits of the *Terai* ecological region especially with respect to its chelonian and other herpetological fauna are similarly unknown. It is therefore necessary to collect detailed hard base line data about the faunal limits of the *Terai* region to enable future reassessment of species distribution limits as these may change over time.

There are also a number of species such as *G. hamitoni* and *H. thurjii* found in lentic and slow flowing lotic water-bodies that are data deficient, whose present day distributions can only be conjectured. As these are large batagurid turtles that are in high demand as edible species and susceptible to high mortality in fishing nets, there is urgent need to assess their present day distribution and conservation status as well.

Breeding pools of all species need to be established in captivity to develop assurance stocks of turtles at Kukrail Gharial (& Turtle) Rehabilitation Center near Lucknow, Sarnath Turtle Rehabilitation Center near Varansi, Garhaita Turtle Conservation Center near Etawah and also in the Kanpur and Lucknow zoos especially for endangered species like *Batagur kachuga* and *Chitra indica* on priority basis.

Socio-economic studies should be initiated in and around all the potential turtle habitats to understand the impact of anthropogenic pressures and relationships. Sustained public awareness programs aimed at curbing hunting of turtles especially in habitats inhabited by endangered and threatened species need to be initiated early.

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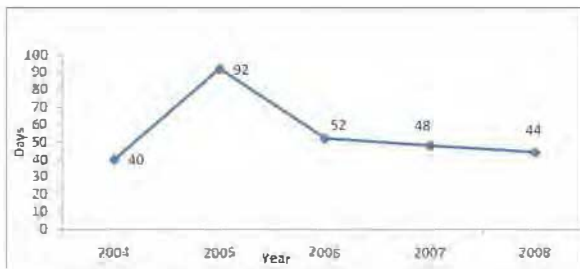
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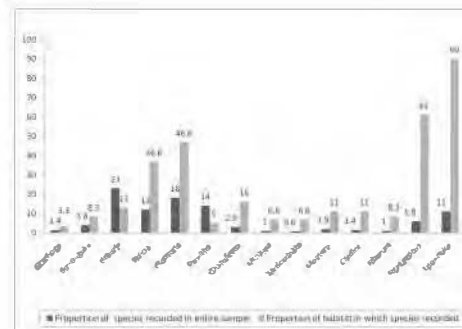
Annexure-1: Sample "HABITAT DATA SHEET".

1	Name of Water-Body	Sidhbaba, Mala River, Pilibhit
2	Date of visit	23.01.05 and again from 09.003.05 to 12.03.05
3	Approach route	Lucknow-Pilibhit-Richhola
4	Mode of travel	Lucknow-Pilibhit: train; Pilibhit (Gouhania square)- Richhola: bus; Richhola to Sidhbaba 3km bicycle or any other local transport. The site is easily accessible from road as the road to Madho Tanda from Pilibheet passes by this habitat.
5	Distance of water body from nearest human habitation	About 10 km from Kalinagar.
6	GPS reading of water body	28°37'58.7"N 79°58'30.5"E
7	Size of water-body	2 Ha
	Description of Weather conditions	Ta: 15°C; RH: max:77%; rainfall was observed since the early hours of that day, at time of observation- partly sunny, humid, beaufort scale 1 Tw: 13°C; min: 79%
8	Type of water body and legal status	This is a lotic pool of the Mala River - (which passes through the <i>Shorea robusta</i> forests of the Mala Range of North Pilibhit Forest Division. At Sidhbaba the depth of the river is ca. 20 feet. In the other sections of its course the stream may be shallow and braided passing over swampy areas.
9	Shoreline type	Gentle
10	Description of shoreline vegetation	Jamun (<i>Syzygium cumini</i>), bilsa, grasses comprise the shoreline vegetation. In many parts the banks are bordered by thick cover of <i>Phragmites</i> .
11	Description of aquatic vegetation	Diverse species of lily, <i>Phragmites</i> spp., <i>Chara</i> , <i>Potamogeton</i> , <i>Chlorella</i> , <i>Volvox</i> , <i>Nymphaea</i> , <i>Vallisneria</i> , Algal species etc.
12	Level of human impact	Moderate- The Mala River is auctioned for fishing by the Forest Department and the contractor engages various fishing parties (mostly ex-patriate Belgali community members) to fish in different sections of the contracted stretch of river. Fishermen use fixed fish traps that barricade entire river. However the number of fishermen who fish in the area is strictly regulated by the contract system.
13	Occurrence of turtle hunting	Turtle hunting is done by resident Bengalis mostly for consumption. Previously turtles used to be openly sold in local markets for local consumption but in more recent times turtles are consumed clandestinely by fishermen who directly participate in fishing. Turtles are incidentally caught in fish traps that are used on the Mala river but several fishermen possessed three pronged iron probes for hunting turtles.
14	Sighting and occurrence of turtles	No turtles seen or caught on first visit- Sampling were carried out by two field assistants who used three pronged iron probes to look for turtles under the silt or amidst <i>Phragmites</i> grasses. On the 25 th of Jan a female <i>Melanochelys tricarinata</i> was captured by hand in Dhamela compartment of Mala range, it was measured and photographed and released at the point of capture. The dimensions, cloacal temperature of the turtle were measured- During the second visit from 08 to 130305 the following turtles were captured. <i>M. trijuga</i> -2, <i>P. tecta</i> -5, <i>G. hamiltonii</i> -1, <i>M. tricarinata</i> -1, <i>L. p. andersonii</i> -1. Details of all specimens examined are included in turtle data sheets attached.
15	Assessment of potential as turtle habitat	This is a habitat lying within a reserve forest, which has dense forests that are fairly well protected. In spite of some regulated fishing and some clandestine hunting and consumption of turtles still the populations seem secure.
16	Contact persons	DFO N. Pilibhit Sri Neeraj Kumar; R.O Mala range- M.P singh
17	Future Study requirements and Action	Detailed studies are warranted to precisely determine the baseline status of the 5 confirmed and 3 other reported species. There is also need to enhance awareness and sensitize local Bengali fishing communities about turtle conservation.

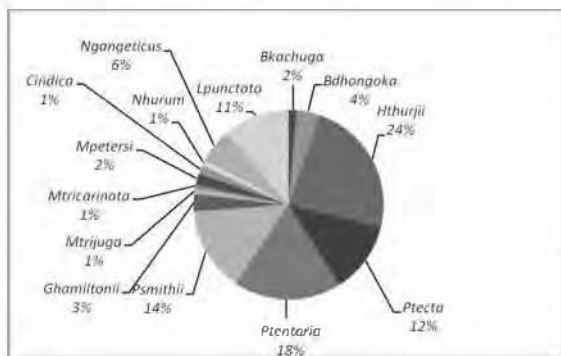
Plate 9



(A)



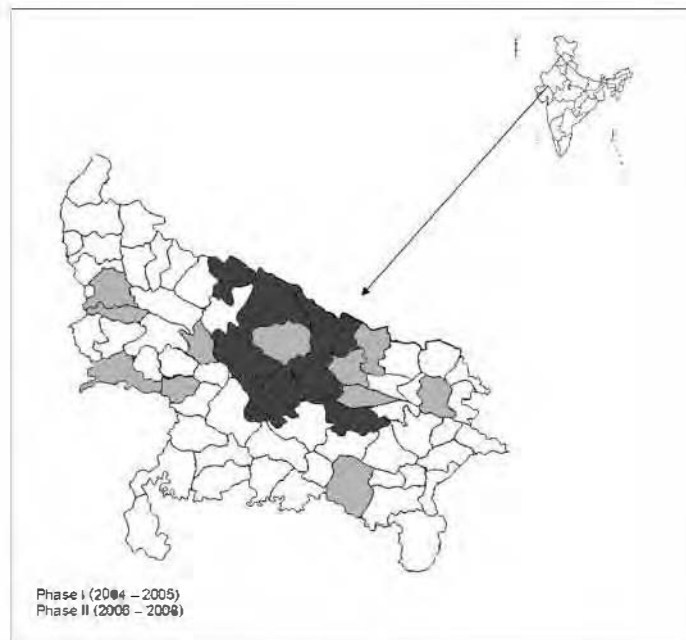
(B)



(C)



(D)



(E)

(A): Survey days during the study period; (B): Proportion of turtle species sampled Vs locations of Occurrence; (C): Species wise (round off) proportion of the different turtle species in entire sample; (D): A Group of *Hardella* foraging on the Sarju River and (E): Map of Uttar Pradesh showing the districts covered in Freshwater Turtle Surveys

Chapter 10

Status, Distribution and Ecology of the Indian Flapshell Turtle, *Lissemys punctata*

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Introduction

The Indian subcontinent with 33 species has one of the most diverse chelonian fauna of the world; five marine, 24 freshwater and four land species. This includes eight species of softshell turtles; *Amyda cartilaginea*, *Nilssonia gangetica*, *N. hurum*, *N. leithii*, *N. nigricans*, *Pelochelys cantorii*, *Chitra indica* and *Lissemys punctata*. The flapshell or mud turtle of the genus *Lissemys* is currently known from two species, *Lissemys punctata* and *L. scutata*, and the later is distributed in Myanmar. Presence of three claws in each limb, femoral flaps, nasal septal ridges and moveable anterior plastral lobe are the key identification features of this species. Some information on taxonomy, distribution and ecology of the Indian turtle fauna is available in Smith (1931) and Das (1995). However, precise data on the biology of majority of the softshell turtles is scanty. In this paper updated information on the distribution and ecology of the Indian flapshell turtle, *Lissemys punctata* is presented.

Status and Distribution

The Indian flapshell turtle is restricted to the Indian sub-region and two subspecies; *L. p. punctata* and *L. p. andersoni* are reported (Webb, 1982). The carapace and soft body parts of *L. p. punctata* are olive-green to brownish-green in young that may have black markings. The subspecies *L. p. andersoni* has an olive-green carapace and soft body parts, with yellow blotches (Webb, 1980). The subspecies *L. p. punctata* is distributed in Sri Lanka and peninsular India and *L. p. andersoni* in Pakistan, northern India, Nepal and Bangladesh and parts of north-western Myanmar. Barring a few northeast Indian states, the Indian flapshell turtle is distributed in all states in India. It is believed that this species was introduced into the Andaman Islands.

Countrywide and regional surveys showed that the Indian flapshell turtle is common and the most frequently observed of any turtle species in India (Moll, 1984; Das, 1986; Vyas and Patel, 1990; Bhupathy and Vijayan, 1991). Literature compiled on the species indicates that it is known from at least 153 localities within India, and is common at 88 of them (Bhupathy, unpublished data). This includes about one fourth of the locality records from the Protected Areas such as the Wildlife Sanctuaries and National Parks (Plate 10 A).

The Indian flapshell turtle and its eggs are heavily exploited for food. The quantum (number) of turtles reaching the Kolkata markets might have reduced in recent years; 50-70 thousand turtles/ year in early 1980s (Whitaker, 1997) and about 2000- 4000 during 1991- 1993 (Choudhury *et al.* 2000). Due to stringent action taken by the Forest Department of West Bengal, turtle trade has either been controlled or has gone underground. One kilogram of turtle meat in the Kolkata market was sold at ' 50 during 1991, and elsewhere in the country, this price might have varied from ' 15 to ' 150 for the same quantity.

Habitat

The Indian flapshell turtle inhabits a variety of aquatic habitats, ranging from rivers and streams to reservoirs, marshes, ponds, lakes, and even salt marshes, rice fields, and gutters in metropolitan areas (Das, 1995). It is common in brackish water habitats in Sunderbans, West Bengal; Bhitarkanika, Orissa; and Coringa, Andhra Pradesh. It prefers relatively shallow waters, which may be devoid of aquatic vegetation, and they may spend long periods partially buried in the bottoms or along the edge of the wetlands. Of the 119 localities, where the species occurs in India, 37% harbours ponds and 3% had coastal wetlands (Plate 10 B).



Food

The Indian flapshell turtle is an omnivore. Food items include adult frogs, tadpoles, fish, crustaceans, molluscs, earthworms, insects, carrion, and water plants (Das, 1995). Bhupathy and Vijayan (1993) quantified its diet from 71 faecal samples and reported both animal and plant items (Plate 10 C). It is suspected of being destructive to fish populations (Deraniyagala 1939). A study conducted in the Keoladeo National Park, Bharatpur showed that most fish consumed were either dead or dying (Bhupathy and Vijayan, 1993). Aquatic plants eaten include grass, water lilies and the bladderwort, and seeds and fruits of a few tree species (Bhupathy and Vijayan 1993).

Predators

Apart from human exploitation for food, mortality is caused by a variety of predators. They include for adult: mahseer, mugger crocodile, large softshell turtle, white scavenger vulture; and eggs: otters, mongooses, jackals, rhesus macaques and monitor lizards (Deraniyagala, 1939; Bhupathy and Vijayan, 1994; Das, 1995).

Adaptations

Ability to completely close the shell concealing soft body parts, and secretion from two pairs of Rathke's glands could protect this species from predators to some extent. Aestivation and hibernation during harsh climatic conditions might be responsible for wide distribution and healthy populations in many parts of its distribution. When shallow ponds and lakes dry up in the summer months; this species may undergo aestivation up to 160 days (Bhupathy and Vijayan, 1994). During aestivation, in Keoladeo National Park, Bharatpur, the turtles bury to a depth of about 50 mm (n=304). Annandale (1912) reported hibernation of this species during winter months in the northern part of its range.

Breeding

Climatic factors such as rain appear to influence breeding in this species, but sporadic nesting is reported round the year as well. Clutch size varies from 2 to 15 eggs and multiple clutches are laid in a single breeding season. The eggs are white, spherical and brittle-shelled. This species has a prolonged incubation period ranging from 240 to 412 days; eggs laid during the monsoon of the previous year hatch during the onset of monsoon of the subsequent year. Vijaya (1982) reported breeding of this species in captivity.

Conservation

The Indian flapshell turtle is protected under Schedule I of the Indian Wildlife (Protection) Act 1972. Moll (1984) and Choudhury and Bhupathy (1993) have recommended down listing this species to Schedule IV considering its common and wide spread distribution. However, abiding by the precautionary principle, the Government of India continues to keep it under Schedule I. This species is listed in Appendix II of the CITES and as Lower Risk in the IUCN 2007 Red List. In spite of the species being so common, ecology of the species is poorly known and studies on this species in larger geographical scale would provide more insights on its adaptability and biology.

Acknowledgements

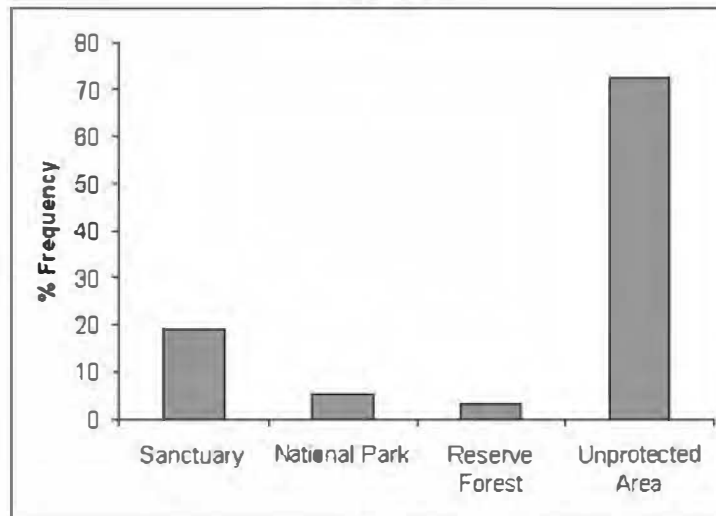
I am grateful to the Bombay Natural History Society, Mumbai (J. C. Daniel), Wildlife Institute of India, Dehra Dun (B.C. Choudhury), U.S. Fish and Wildlife Service, USA (David Ferguson) and Sálim Ali Centre for Ornithology and Natural History, Coimbatore (V. S. Vijayan) for supporting research on Indian turtles.

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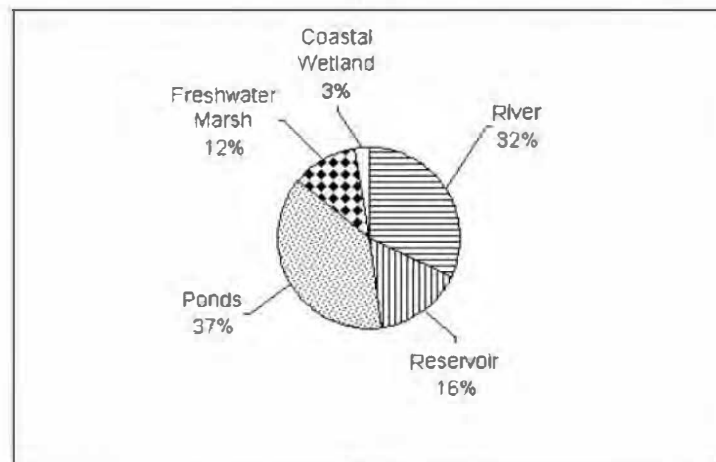
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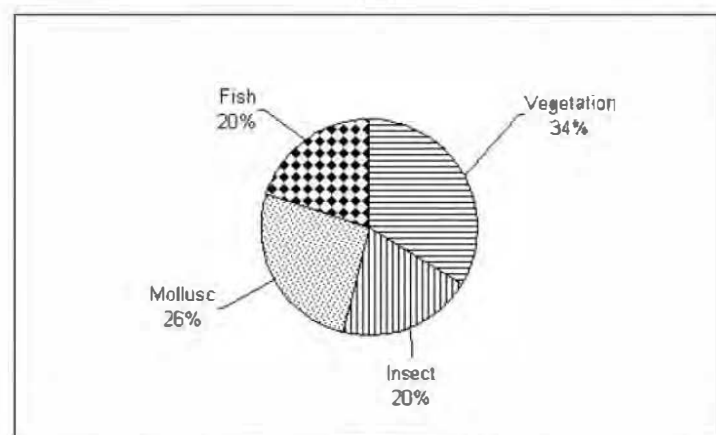
Plate 10



(A)



(B)



(C)

(A): Distribution of the Indian flapshell turtle in various categories of forests in India; No. of locations included = 153; (B): Distribution of the Indian flapshell turtle in various habitats; No. of records analysed = 119 and (C): Food of the Indian flapshell turtle; No. of samples analysed = 71; Bhupathy and Vijayan (1993).

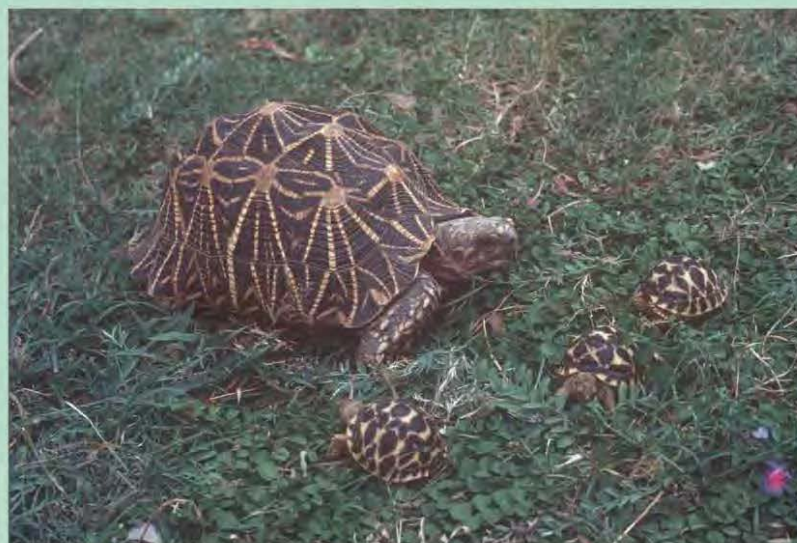
The Indian Star Tortoise (*Geochelone Elegans*)

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The Indian Star Tortoise (*Geochelone elegans*) is a small tortoise with colourful markings. The habitats of the species are being lost very rapidly from its entire distributional geographical range. The species is widely distributed and found in dry and arid regions of Pakistan, India and Sri Lanka.

The geographical distributional pattern of species clearly illustrates that the species is discretely distributed in three sub-populations, i.e., two distinct populations on the main land and the third on the island of Sri Lanka. There is very little information on the ecology, biology, genetic variation and conservation value of the species.

Population	Geographical Area Occupancy (Approx) km ²	% geographical area occurred by each sub-population	Country (Region)
North-western	384656	50	Pakistan (Sindh), India (Gujarat, Rajasthan, Madhya Pradesh)
South-eastern	334959	44	India (Kerala, Karnataka, Andhra Pradesh, Orissa, Tamil Nadu)
Sri Lanka	45927	6	Sri Lanka



A female of Star Tortoise and hatchlings from North-Western Population

Chapter 11

The Status of North-Western Population of Star Tortoise (*Geochelone elegans*)

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Introduction

The star tortoise (=IST) (*Geochelone elegans*) is a medium sized, herbivorous terrestrial diurnal tortoise belonging to family Testudinidae, and is widely distributed over large parts of the Indian subcontinent (Plate 11 A).

The species is distributed in the dry regions of south-eastern and southern India, north-western India, Sri Lanka and extreme south-east Pakistan (Daniel 1983; Iverson and College 1992; Jayson 1993). It is primarily found in dry deciduous to scrub forests and grasslands to coastal scrublands of arid and semi- arid regions (Daniel 1983; Das 1995).

Legal Status of Species

Currently star tortoise is legally protected under the Schedule IV of the Wildlife (Protection) Act 1972 (amendments 2005) and internationally considered as Appendix II in CITES. The Indian population was assessed "Vulnerable" at the 1997 BCPP Conservation Assessment and Management Plan (CAMP) Workshop according to 1994 IUCN Red List Criteria (Molur and Walker 1998). Asian Turtle Trade Working Group (2000) assesses the species as globally "Lower Risk/Least Concerns" in the Red Data List, IUCN. Such status is explained at lowest value for the conservation.

Geographical Distribution

The geographical distributional pattern of species clearly illustrates that the species is discretely distributed in three sub-populations, i.e., two separate populations on main land and third on the island of Sri Lanka (Plate 11 D).

The main land population has been recognized by two separate populations. The animals from the Northern parts of the Indian subcontinent are large and have relatively dark ground coloration. Whereas the animals from the southern parts are smaller with a more intense and contrasting pattern (Frazier 1992). And third population from Sri Lankan specimens looks quite alike the animals of the Southern "type", but grows much larger and has more yellow tinge in their carapacial radiating lines than the Indian variants (De Silva 2003).

Presently, taxonomists consider all the sub-population as one species *Geochelone elegans*. But various sources of information suggest that this species occurs in three sub-populations i.e. 1) North-western, 2) Eastern-southern, and 3) Sri Lankan populations are morphologically recognizable forms and possibly taxonomically distinct (Choudhury and Bhupathy 1993). The three geographically separated populations are phenotypically different and there is a possibility that this species could consist of several subspecies.

Distribution of the North-Western Population

Literatures suggest that the north-western population of the star tortoise is confined between the western limit being Nagar Parkar of Thar Desert in Pakistan and the eastern limit being Sariska Wildlife Sanctuary, in Rajasthan, India. The southern limit lies north to Pavagadh Hills of Panchmahal District, Gujarat. There is only a single published report of the species from Mandsapur District, Madhya Pradesh. This habitat pocket is situated in between Chambal River and the adjoining state Rajasthan. Also, a report of the species from Sailana Wildlife Sanctuary exists, but it needs confirmation.

Habitat

A total of 31 Protected Areas come under the entire distributional range of the north-western population of star tortoise. These PAs are: one in Sindh Province, Pakistan and 30 in three states of India (Rajasthan-14, Gujarat-15 and Madhya Pradesh-1). This PA network specifies that total 20,186.74 km² of area is legally protected. These PAs have habitats curcial for the species (Table-1).



Table-1: The list of Protected Areas falling under the distributional range of North-western population of star tortoise (*Geochelone elegans*).

In last few decades, various surveys of the north-west population of the star tortoise, covering 22 PAs revealed that the species is present in 8 and 11 PAs of Rajasthan and Gujarat, respectively. The status of species from each PA is given in Table-2.

Table-2: The list of surveyed Protection Areas from the entire distributional range of north- western population of star tortoise (*Geochelone elegans*).

Sr. No.	Name of the Protected Area.	Area Sq. km	Total area of PA Habitat in each region
	Pakistan, Sindh Province		
1	Rann of Kutch Wildlife Sanctuary	3204.63	3205.00
	India, Rajasthan State		
2	Ranthambore National Park	392.00	
3	Sariska National Park and Wildlife Sanctuary	765.80	
4	Ramgarh Vishdhari Wildlife Sanctuary	301.00	
5	Jaisamnd Wildlife Sanctuary	52.00	
6	Bassi Wildlife Sanctuary	152.90	
7	Bhensrodgarh Wildlife Sanctuary	229.14	
8	Kumbhalgarh Wildlife Sanctuary	578.25	
9	Jamwa Ramgarh Wildlife Sanctuary	300.00	
10	Nahargarh Wildlife Sanctuary	50.00	
11	Sajjanganrh Wildlife Sanctuary	5.19	
12	Phulwari ki Nal WS	511.41	
13	Mount Abu Wildlife Sanctuary	288.84	
14	Sitamata Wildlife Sanctuary	422.94	
15	Tadgarh Raoli Wildlife Sanctuary	495.27	4544.74
	India, Gujarat State		
16	Gir National Park and Wildlife Sanctuary	1412.13	
17	Balaram-Ambaji Wildlife Sanctuary	542.08	
18	Jessore Sloth bear Wildlife Sanctuary	180.66	
19	Barada Wildlife Sanctuary	192.31	
20	Hingolghadh Wildlife Sanctuary	6.54	
21	Pania Wildlife Sanctuary	39.63	
22	Rampara Wildlife Sanctuary	15.01	
23	Velavadar National Park	34.08	
24	Gaga Bustard Wildlife Sanctuary	3.33	
25	Wild Ass Wildlife Sanctuary	4953.70	
26	Lalaji Bustard Wildlife Sanctuary	2.03	
27	Narayan Sarovar WS	444.23	
28	Kachchh Desert Wildlife Sanctuary	7506.22	
29	Mitiyala WS	18.22	
30	Girnar WS	178.87	15529.04
	India, Madhya Pradesh		
31	Sailana Wildlife Sanctuary	12.96	12.96
	Total Area		20186.74

In last few decades, various surveys of the north-west population of the star tortoise, covering 22 PAs revealed that the species is present in 8 and 11 PAs of Rajasthan and Gujarat, respectively. The status of species from each PA is given in Table-2.

Table-2: The list of surveyed Protection Areas from the entire distributional range of north- western population of star tortoise (*Geochelone elegans*).

No	Protected Area	Status of Species	Area of PAs (Sq. km)	Source
INDIA				
Rajasthan				
1	Ranthambore NP	Rare	392.00	Sunni Patil (Personal Communication)
2	Sariska NP and WS	Reported	765.80	Biswas and Sanyal, 1977
3	Kumbhalgarh WS	Rare	578.25	Gaur and Pandey, 2007
4	Jamwa Ramgarh WS	Rare	300.00	Sharma, 1998
5	Nahargarh WS	Rare	50.00	Sharma, 2000
6	Sajjargarh WS	Rare	5.19	Sharma, 1999
7	Phulwari ki Nal WS	Reported	511.41	Sharma, 2001
8	Mount Abu WS	Rare	288.84	Sunni Patil (Personal Communication)
Gujarat				
9	Gir NP and WS	Common	1412.13	Frazier, 1988; Bhatt <i>et al.</i> 1998 Vyas, 2000a, 2000b and 2001
10	Balaram-Ambaji WS	Common	542.08	Vyas and Parasharya, 2000
11	Jessore Sloth bear WS	Common	180.66	Vyas and Parasharya, 2000; Vyas, 2005
12	Barada WS	Uncommon	192.31	Bhalodia <i>et al.</i> , 2001b
13	Hingolghadh WS	Uncommon	6.54	Vyas, 2000c
14	Pania WS	Uncommon	39.63	Vyas and Parasharya, 2000
15	Rampara WS	Uncommon	15.01	Bhalodia <i>et al.</i> , 2001
16	Velavadar NP	Not Reported	34.08	Vyas and Gadhvi, 2003
17	Gaga Bustard WS	Uncommon	3.33	Vyas and Parasharya, 2000
18	Wild Ass WS	Uncommon	4953.70	Vyas and Parasharya, 2000
19	Lalaji Bustard WS	Uncommon	2.03	Vyas and Parasharya, 2000
20	Narayan Sarovar WS	Uncommon	444.23	Vyas, 2002
21	Kachchh Desert WS	Not Reported	7506.22	Vyas, 2007
Madhya Pradesh				
22	Sailana W S	Reported	12.96	R. Sankaran (Personal Communication)

Non-PAs and Habitat Status

Anderson and Minton (1963) reported star tortoise from Nagar Parkar, Thar Desert of Pakistan as most western limit of the species, after which there was no subsequent information regarding the species. Nagar Parkar is a very large habitat area of dry arid and thorny scrub pockets on the north border of Great Rann of Kutchh. The status of star tortoise in this area is indeterminant but it is likely that the species is found in this area.



The star tortoise is reported from many sites outside protected areas of Rajasthan, Gujarat and small portions of Madhya Pradesh too (Table-3). The survey results of Frazier (1987), Das (1995), Vyas and Parasharya (2000) and Vyas (2006) state that the species is largely distributed in 12 districts of Rajasthan and 16 districts of Gujarat, especially agricultural, scrubs, thorny scrubs, arid and grass land habitat. Over all these are the very large habitats for the species, where a sizeable population of the species might inhabit.

Vyas and Singh (2004) reported the species from Madhya Pradesh near the Gandhi-Sagar reservoir at Mandsapur District. This habitat is comprised of scrub vegetation (Plate 11 B and 11C). It is the only remaining habitats for the species because such habitats were submerged during the construction of the dam. The area occupied by the star tortoise outside PAs is majority of the area where the north western population is distributed.

Table-3: The list of district wise location habitat area (non- Protected Area) of north-western population of Star tortoise (*Geochelone elegans*).

No	Country / Region / District (Location)	Reference/ Source
	PAKISTAN, Sindh Province	
1	Nagar-Parkar, Thar Desert	Anderson and Minton, 1963
	INDIA , Rajasthan State	
1	Banswada	R. Vyas (Unpublished Observation)
2	Barmer (Mokalsar, Rakhi, Siwana)	Frazier, 1987
3	Bhilwara	Frazier, 1987
4	Chitorgarh	Frazier, 1987
5	Dungarpur	Frazier, 1987; Saxena, 2003
6	Jaipur	Frazier, 1987
7	Jalor (Erinpura, Bibar, Sanchor)	Frazier, 1987
8	Jodhpur (Bisalpur)	Frazier, 1987
9	Pali (Barr)	Frazier, 1987
10	Sawai Madhopur (vicinity Ranthabor NP)	Sunny Patil (Personal Communication)
11	Sirohi (Abu Road)	R. Vyas (Unpublished Observation)
12	Udaipur (vicinity Jaisamand WS, Kirat, Jhadol)	Frazier, 1987; Sharma, 2001; 2003 and 2004; Bhatnagar and Mathur, 2008
	INDIA, Gujarat State	
1	Ahemdabad (Koth, Sarkhej)	Vyas and Parasharya, 2000
2	Amreli (Dhari)	Vyas and Parasharya, 2000
3	Anand (Borsad)	Vyas and Parasharya, 2000
4	Banaskantha (Dhanera, Dantiwada, Iqubal Gadh, Palanpur, Rasarpur)	Vyas and Parasharya, 2000 Gayen, 1999
5	Bhavnagar (Sihor)	Vyas and Parasharya, 2000
6	Gandhinagar (Koba)	Vyas and Parasharya, 2000
7	Jamnagar (Lalpur)	Vyas and Parasharya, 2000
8	Junagadh (Satadhar)	Vyas and Parasharya, 2000
9	Kheda (Chakalasi, Isanpur, Kapadvanji)	Vyas and Parasharya, 2000
10	Katchh (Mundra, Mandvi)	R. Vyas (Unpublished Observation)
11	Mehsana (Becharaji, Vijapur)	Vyas and Parasharya, 2000
12	Panchmahal (Chapaner)	Vyas and Parasharya, 2000
13	Rajkot (Vankaner)	Vyas and Parasharya, 2000
14	Sabarkantha (Vatrak, Ider)	Vyas and Parasharya, 2000
15	Surendranagar (Dhangdhara, Wankaner)	Vyas and Parasharya, 2000
16	Vadodara (Savali, Timba)	R. Vyas (Unpublished Observation)
	INDIA , Madhya Pradesh	
1	Mandsapur (Gandhisagar Reservoir)	Vyas and Singh, 2004

Threats on the Sub-Population

Five major threats are recorded in the entire distributional range of the north-western population of star tortoise (Table-4). These threats are responsible for depletion of the population of the star tortoise in its range. Habitat destruction by fragmentation or alteration is among the important threats to the species. Population of the species inhabiting protected areas also experience threats. Some forestry practices are not compatible with the goal of sustaining a viable population of the species (Vyas 2006).

Pet trade is also one of the major threats for star tortoise populations. Large numbers of animals are illegally collected from their habitats, smuggled for local, national and international pet markets. This threat is not specific on the north-western population of star tortoise. It has been repeatedly documented that animals are collected from entire distributional range as a source of food (Moll 1989).

Table-4: The list of various recorded threats on north-western population of the Star Tortoise (*Geochelone elegans*).

No.	Type of threats	Size of threats
1	HABITAT DESTRUCTION -Fragmentation - Alteration - Habitat loss	High
2	AGRICULTURE PRACTICE -Pesticides, herbicides -Crop pattern -Protection devices for crop field -Irrigation canal network	High
3	FOREST MANAGEMENT -Fire line practice -Management plan on basis of only bigger or single species conservation guidelines, uncovered entire biodiversity	Moderate
4	-Interior blocks and boundary demarcations with concrete wall -Plantation works -Collection of grasses, grazing by livestock	High
5	PET TRADE - loss of gene pool DEVELOPMENTAL ACTIVITIES - Expanding Road network - Expanding Railway network - Urbanization - Irrigation Canal Network	Moderate

Conclusion

The assessment of the north-western population of star tortoise reveals that a significant population of the species occurs outside PAs and it needs special measures for conservation. Research targeting the ecology, reproductive biology, ex-situ needs and population assessments will help in developing species recovery plans.

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Plate 11



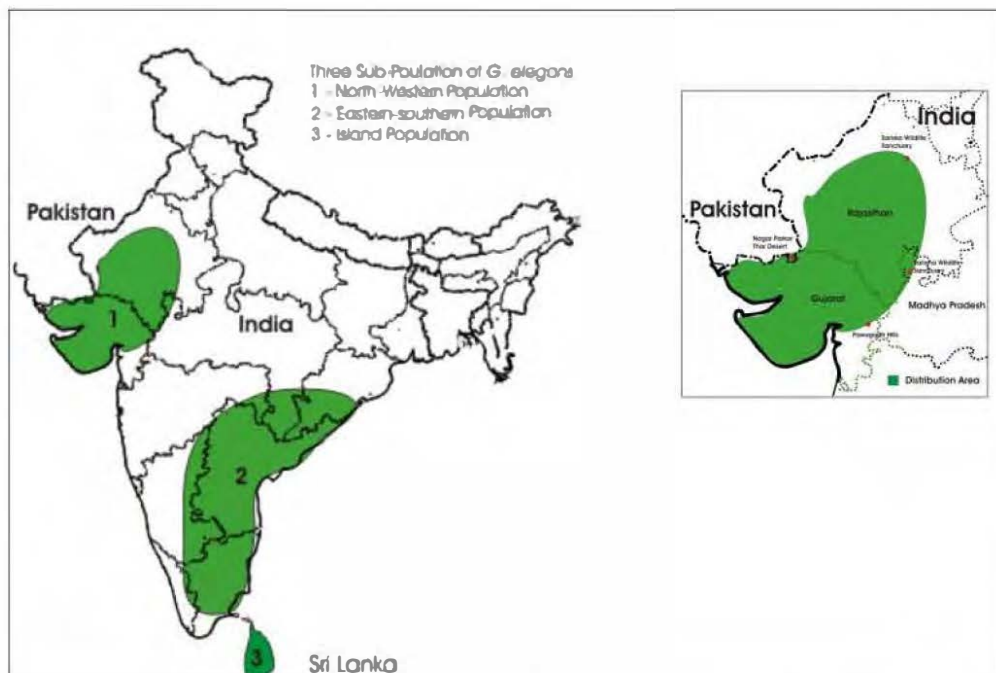
(A)



(B)



(C)



(D)

(A): Hatchling of Indian Star Tortoise; (B): Thorny-scrub forest areas near Pakistan border, Kutchch Desert Wildlife Sanctuary; (C): A typical habitat of Indian Star Tortoise, Near Sihor, Bhavanagar District, Gujarat and (D): The Geographical Distribution of North-Western Population of Indian Star Tortoise *Geochelone elegans*

A Natural History Account of the Tricarinate Hill-Turtle

Melanochelys tricarinata in the Doon Valley, Northern India

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Introduction

The Tricarinate Hill-turtle *Melanochelys tricarinata* belonging to the family Geoemydidae that includes the semi aquatic pond turtles is a small terrestrial turtle, attaining 174 mm in length and restricted to the northern parts of the Indian subcontinent (Das, 2009). The name of the turtle is derived from the presence of three prominent yellow lines/keels on its brownish-black carapace (Plate 12-A and B). This along with the yellow plastron distinguishes it easily from its only congener, the Indian Black turtle *Melanochelys trijuga*, and all other semi-aquatic pond turtles. *M. tricarinata* is more generally reported from the Himalayan foothills and riverine grasslands along the river Ganga and Brahmaputra (Boulenger, 1890; Smith, 1931; Pritchard, 1979; Ernst and Barbour, 1989; Choudhury and Bhupathy, 1993a; Busack, 1994; Das, 1991, 2009; Mitchell and Rhodin, 1996; Schleich and Kastle, 2002). However, the records by Khan (1987) from the Whykong reserve forest, Cox's Bazar district of Bangladesh suggest the occurrence of the species at a considerable distance from the Himalayan ranges. In addition, the species is also known to occur in the Sal (*Shorea robusta*) dominated forests of Chaibassa district, Jharkhand (Das, 1991), from where it was originally described (Blyth, 1856), and recently recorded in the Simlipal Tiger Reserve in northern Orissa (Dutta *et al.* 2009).

The *M. tricarinata* is included in the Schedule I of the Indian Wildlife (Protection) Act of 1972, and listed in the Appendix 1 of CITES and classified as Vulnerable on the IUCN Red List (Asian Turtle Trade Working Group, 2000), however still, it is a poorly known species with virtually no information on its population status, habitat requirements, habit, diet or breeding biology from the wild. Knowledge of the life history of the species is almost entirely a result of observations from few captive individuals (Tikader and Sharma, 1985; Das, 1988; Mitchell and Rhodin, 1996; Valentin and Gemel, 1999). Destruction of primary forests (Das, 2009), and exploitation of the species for food and commercial trade are concerns for the survival of the species (Tikader and Sharma, 1985; Choudhury and Bhupathy, 1993a,b; Das, 1995; Javed and Hanfee, 1995; Mitchell and Rhodin, 1996; Shrestha, 1997; Zhou *et al.*, 2008; Gong *et al.*, 2009). Here, we present natural history accounts of *M. tricarinata* based on observations of the turtles recorded (capture/recapture), over a period of 10 years from 1998 to 2008 from within the Wildlife Institute of India (WII) campus located in the Doon Valley, northern India.

***M. tricarinata* in the WII campus.** – The tricarinate hill-turtle is the most commonly recorded species within the WII campus. Three other testudines were also recorded though only occasionally within the campus; three Indian flapshell turtle *Lissemys punctata*, two *M. trijuga* and one Yellow-headed Tortoise *Indotestudo elongata*. The WII campus with an area of 32 hectares is located near to the Shivalik hills along the southern end of the Dehradun city in the Doon Valley in the Uttarakhand state (Plate 12-C), and the natural vegetation consists of Sal forest with a dense understory dominated by bushes of *Lantana camara*, *Carrisa opaca*, *Maclura cochinchinensis* and *Jasminum multiflorum*. Also, the area is interspersed with few perennial water sources and a man-made lake. The adjoining part of the campus is contiguous with the Rajaji National Park in the Siwalik landscape.

A total of 110 *M. tricarinata* were captured and marked in the campus during the study period; 38 of these were males, 36 were females, 15 were juveniles and 21 were hatchlings. Apart from this ten other turtles (9 males and 1 female) were also captured from the adjoining areas of the campus. These turtles were further recaptured on 154 occasions during the study. The capture-recapture data on the campus of WII suggests that the turtle population is within the range of 30-40 individuals per year (*Unpublished data*).

Marking turtles

In order to identify each turtle captured in the area, permanent markings were made by filing notches into the marginal scutes of the carapace following Cagle (1939). In the genus *Melanochelys* a total of 12 marginal scutes are present on either side of the carapace, and of these only three in the anterior and five in the posterior can be

used for marking as the four other scutes are connected to the plastron. For this study, only the posterior marginals scutes, five on either side of the carapace were used for marking. The marginal scutes on the right side were given single digit ID's as 1, 2, 4, 7, and 9 while those on the left were given ID's 10, 20, 40, 70 and 90 starting from the posterior most scutes (Plate 12-D). Only a single notch was made in each of the five marginal scutes and a combination of these scutes was marked depending on the individual ID. Hatchlings and yearlings captured in the area were not marked, as their carapace was very soft and not ossified.

Morphometrics

Body size distribution of the captured turtles was found to be biased towards larger turtles (Plate 12-E). Maximum turtle captures (66.7%) were in the size class of 130 to 170 mm, predominated by males in the size classes between 150-170 mm (74.5%), and predominated by females in the size classes between 130-150 mm (91.9%). The average SCL recorded for adult male and female turtles were 154 mm (range 127-175 mm, $n = 47$), and 138 mm (range 117-151 mm, $n = 37$) respectively. Likewise, average weight of the male and female turtles were 461.5 g (range 280.0-621.4 g, $n = 46$), and 384.4 g (range 240.0-511.1 g, $n = 35$) respectively. The smallest hatchling caught had an SCL of 33 mm and weighed around 8.0 g, while most other hatchlings were between 40 and 60 mm in length. Male turtles showed a plastron concavity measuring 7.7 mm on average (range 2.4-12.0 mm, $n = 47$). From the morphometric data obtained adult males of the species were found to be significantly larger than females in the population, which is observed among mostly terrestrial members of the family Testudinidae (true tortoises).

Age of the turtles

Turtles of all age classes based on the count of annuli rings were caught during the study, with a maximum in the seven to nine year age category (32%). Approximate age of each turtle was determined by counting the annuli rings on the pleural scutes (technique reviewed in Wilson *et al.* 2003). A comparison of the number of annuli rings from year of first capture and year of last capture in few turtles suggested the fact that over the age of 12 yrs the annuli rings appear less distinct. All unsexed juvenile turtles had five or less number of annuli rings, and hatchlings had a single ring. Four unsexed juveniles having five annuli rings at first capture were found to be males, showing a partial plastron concavity when recaptured the following year. Also, in these young male turtles, the superciliary stripe was less prominent and beginning to pale. Adult male turtles lacked the pink supercilium, while adult female turtles retained the stripe.

Habitat and Ecology

The species was found to be terrestrial as has been previously reported (Das, 2009). Turtle capture/recapture locations were mainly in the well wooded parts of the campus, with 60% of these recorded within an area of around one hectare at the northern end of the campus adjoining the man-made lake. This area is relatively less disturbed and is characterized by dense stands of young Sal (GBH = 36 mm, $n = 50$), with an understory of *L. camara*, *Carrisa opaca* and *J. multiflorum*.

Most turtle capture/recaptures (94.4%) occurred during the monsoon months (June to August), while no individuals were observed from November to February (winter months) in the area during the survey years. In general, capture frequency was significantly correlated with periods of high rainfall; 54% of the captures were made during July alone when the monsoon rains are at its peak in the area. Further, turtles were invariably observed on the trails at the time of heavy downpour. Based on the time of capture of individuals, the species appears to be crepuscular in activity as most captures (73.8%) were during the morning (0700 to 1100) and evening (1500 to 1800) hours and none were encountered at night. The periodicity in captures suggests that turtles are most active with the onset of the pre-monsoon showers in the area and then remain active until the onset of winter, following which they probably go through a long period of inactivity, possibly hibernating for six to seven months (October to April). On two occasions (17 October 2002 and 3 January 2009), turtles were found in burrows in the ground when they were accidentally dug up.

Five observations of mating were recorded in the area, and each lasted for more than 30 minutes. The longest duration a mating pair was observed mounted was 37 minutes, though the mating duration is likely to be longer as the turtles when first sighted were already mounted. Except for a single mating observation in August all others were observed in the month of July. Based on the annuli rings the males in the mating pairs were between 8 to 10 years, while female turtles were between 7 to 13 years. Also, the average SCL of the male turtles was 161.0 ± 6.0 mm, and was 140.0 ± 2.0 mm in the females. No nests of the species could be located during the study, while hatchlings were located either single or in two or three from the middle of July through August.

Interestingly, hatchling emergence overlapped with the mating activity of the turtles in the area. On one occasion a hatchling was located about 20 m away from a pair of mating turtles on the same day. A single observation of fighting between two large males was observed on 17 July 2005 at 1610 hr, and the turtles were observed trying to bite at each other. There were no female turtles in the vicinity. Both these male turtles had SCL of 167.1 and 161.3 mm, and weighed 566.4 and 538.4 g respectively.

Observations of diet suggested *M. tricarinata* to be omnivorous, feeding on both fruits and animal matter. A total of 53 records for diet of the turtles were collected, of which 34 records were direct feeding observations and most of these were on earthworms. During rains, earthworms were observed brought along by runoff water and collected in natural depressions in certain parts of the trails and paths. And, there turtles were observed to move in and feed on the earthworms. Analysis of turtle droppings showed a high representation of fruits of *J. multiflorum*. Other species of fruits recorded in the droppings, in the decreasing order of their occurrence are: *Ficus* sp., *Cordia myxa*, *Ampelocissus latifolia*, *Broussonetia papyrifera*, *Lantana camara* and *Sapium sebiferum*. Further, unidentified seeds, roots, tubers, vegetable waste in the form of tomato peel, and few animal remains in the form of feathers of a small bird, shell fragments of crab, millipede, beetle elytra, and termite wings were also observed in the turtle droppings. On three occasions turtles were observed in a garbage dump, and another was observed feeding on human faeces outside the campus.

Gaps in information

The Tricarinate hill-turtle has remained poorly studied, and even though the present study has provided valuable information, there is still paucity of information on crucial aspects like breeding biology, activity pattern and habitat requirements. Also, observations from the present study suggest the species to likely hibernate during winter months and this requires further investigation. The present population status and threats to the species across its distribution range is not known. Thus, for a better understanding of the species and for its conservation, studies focusing on the above are suggested to be taken up.

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Plate 12



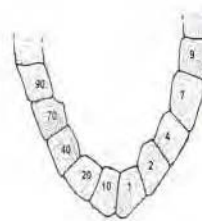
(A)



(B)

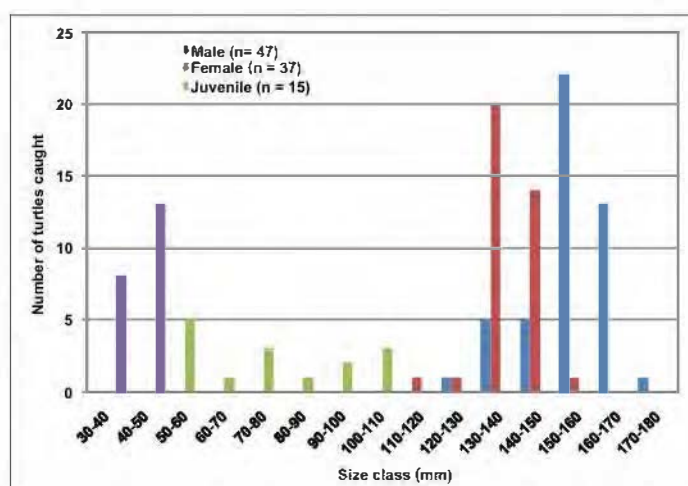


(C)



Turtle ID - 3.

(D)



(E)

(A): An adult male *M. tricarinata* in its natural habitat showing the distinct yellow keels on the carapace; (B): Carapace of *M. tricarinata* showing the three prominent yellow lines/keels; (C): Map showing the distribution range of *M. tricarinata* (based on Das, 2009) and location of the study site in the Doon Valley, Northern India. The location marked with a star is the type locality of the species in the Chaibasa District of Jharkhand State in eastern India; (D): Marginal scute marking pattern employed in this study and (E): Carapace length frequency of *M. tricarinata* between sexes and the unsexed juveniles and hatchlings. Photos A, B and D by: Bivash Pandav

Chapter 13

Indian Turtle Conservation Program: An Overview

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India's freshwater turtles face an unprecedented onslaught of pressures, ranging from intensive harvesting to large-scale habitat loss. Nearly 60 percent of the 28 native turtle and tortoises species are now in danger of extinction.

In call to action, the Madras Crocodile Bank Trust, the Turtle Survival Alliance, and Conservation International jointly developed the "Conservation Action Plan for Endangered Indian Freshwater Turtles and Tortoises", through an exhaustive weeklong workshop in Lucknow, Uttar Pradesh in 2005. National and international turtle biologists, conservationists, university professors, and forest department officers attended the workshop. The action plan identified the ten most threatened turtle species and recommended species-specific conservation actions, to be implemented with the collaboration of various local and regional conservation organizations with facilitation from the Turtle Survival Alliance and the Madras Crocodile Bank Trust.

The Turtle Survival Alliance/Madras Crocodile Bank Trust team quickly started implementing the recommendations for the endangered Red-crowned roof turtle, *Batagur kachuga* (Plate 13 A) in the National Chambal (River) Sanctuary. The Red-crowned Roof turtle conservation program was chosen as the flagship project for the country as the turtle is very charismatic (see photo) and it was felt there was a high probability of the project quickly and successfully securing a viable population of the turtles, all while serving as a model for other turtle conservation programs throughout India and abroad. With fewer than 400 adult females remaining in the wild (based on yearly nesting surveys), decisive conservation actions were clearly warranted.

In four field seasons (2006-2009), more than 350 nests of *B. kachuga* and over 2000 nests of the sympatric three-striped roof turtle, *Batagur dhongoka*, have been protected through the establishment of 11 *in-situ* riverside hatcheries (3-4 hatcheries per year) along the lower and middle Chambal River (Plate 13 B). The vast majority of the hatchlings were released within 24 hours of hatching after being permanently marked by injecting a decimal coded wire tag (DCW) under the dermis of a hind limb and / or a colored plastic cable tie attached to the trailing edge of the rear shell. By surveying for marked turtles, the hope is to document the rates of hatchling survivorship and dispersal. This is crucial part of the project as it is the standardized means of gauging how successful the hatch-and-release program is in augmenting the wild turtle population.

A select few turtles were reserved for headstarting. Headstarting is the practice of rearing juveniles in captivity until they reach a size assumed to afford them greater survivorship when released into the wild. The theory is that juvenile turtles are at the most vulnerable to predation when small, but as they rapidly grow the number of potential predators is greatly reduced. Hence, by headstarting turtles the population will grow at a more rapid rate due to increased survivorship at this vulnerable life history stage.

Two modest headstarting facilities were established in the village of Garhaita, near the town of Etawah, Uttar Pradesh and at the Deori Gharial Rehabilitation Centre near the town of Morena, Madhya Pradesh to facilitate the headstarting in the lower and middle Chambal River (Plate 13 C). Currently more than 1,000 *Batagur kachuga* are being reared in these two facilities with a plan to monitor their survival and movement patterns upon release.

In 2007, this project gained momentum when San Diego Zoo' Institute for Conservation Research joined this turtle conservation effort and was expanded as a joint Turtle Survival Alliance/San Diego Zoo's Institute for Conservation Research/Madras Crocodile Bank Trust's Indian Turtle Conservation Program. The program is now aimed at conserving multiple endangered species of turtles as well as to improve protection of a significant portion of India's endangered turtles' habitats (Plate 13 D and H).



In 2008, we launched a conservation effort for the endangered Indian Narrow-headed soft shell turtle, *Chitra indica* with a grant from Cleveland Metroparks Zoo. This giant (up to 120kg) but delicate turtle species is being extensively hunted throughout its range for its outer cartilaginous rim of its shell, referred here in India as "calipee". [In most of Latin America "calipee" is the term used to describe the fat from green sea turtles, *Chelonia mydas*, used in making "turtle soup". The green sea turtle gets its name from the color of the soup made from this fat. Coincidentally this Indian softshell turtle "calipee" is being used in Asian countries for a very different style and color of gelatinous soup.]

As part of the *Chitra indica* project, we launched a turtle poacher conversion initiative aimed at simultaneously locating elusive remnant breeding populations (via directly engaging -poachers to conserve the turtles rather than harvest them). We also engaged the ex-poachers in additional alternative-livelihood practices on upper Ganges, Yamuna, and Chambal Rivers and in the Terai region (a biodiversity hotspot in the foothills of the Himalayan Mountains). In two field seasons, we protected 25 *Chitra indica* nests (over 2500 eggs!). The nests were moved to *in-situ* hatcheries for safeguarding and over 2000 hatchlings have been released back into the wild (Plate 13 E). This year (2009), five nests have been translocated to hatcheries on Ganges River as well as five nests being protected on the Chambal River. Approximately 150 hatchlings will be transferred to the Kukrail Gharial (and Turtle) Rehabilitation Centre in Lucknow, Uttar Pradesh for headstarting. The remaining majority will be released directly into their riverine habitats.

Additionally, with the help of these former poachers, we have been able to locate a few remnant populations of several other endangered species of Indian turtles, including the Crowned River Turtle (*Hardella thurjii*) and the Indian Eyed Turtle (*Morenia petersii*). Moreover, we were able to help teams from various state forest departments in tracking eight illegal shipments of turtles in the Terai region from information volunteered by participating reformed poachers (Plate 13 F). Furthermore, a community based *Chitra indica* rescue facility was established near the town of Colonelganj in the Gonda district of Uttar Pradesh. This currently functions to hold turtles seized in illegal wildlife trade from the Sarju and Ghaghra rivers on a temporary basis until their release back into the wild.

Our last initiative launched in 2008, was the start of our efforts to conserve the Indian River Terrapin "*Batagur baska*" in Sunderbans of West Bengal. This turtle is India's most endangered turtle as well as being one of the most critically endangered turtles in the world. Currently there are no known breeding populations remaining and less than 20 animals surviving in captivity. Sadly, no captive breeding has been successful to date. [During the 2005 workshop, it was not known that Indian River terrapin (*Batagur baska*) in the Sunderbans was a distinct species from other populations of *Batagur baska* (now known as *Batagur affinis*) in Southeast Asia.] Long-term permission has been sought to launch a captive breeding program at the West Bengal Forest Department Station "*Sajnekhali*" and at the Madras Crocodile Bank Trust using the captive stocks at both facilities. At present, the Madras Crocodile Bank Trust has two adult females but no male. These two females occasionally lay unfertilized eggs; hence, all efforts should be made to secure 1-2 males on breeding loan from Sajnekhali. MCBT has had great success in recent years breeding *Batagur kachuga* and we hope that they can repeat their success with *Batagur Baska* once males have been secured.

In 2009, we launched several new initiatives, including the construction of a "green" energy efficient head-starting facility with solar powered water pumps and bio-filtration systems, aimed to increase the capacity of our turtle headstarting program, the construction of an education center in the village Garhaita, as well as implementing wide-ranging environmental education programs through the Chambal National Sanctuary. Support for these new initiatives came from the Disney Worldwide Conservation Fund, Beneficia Foundation, and the Turtle Conservation Fund.

Today our Indian turtle conservation program is truly comprehensive in nature, with multiple species initiatives that institute multifaceted approaches to turtle conservation and human welfare. We have specifically integrated our *in-situ* and *ex-situ* conservation and research initiatives with activities that address the localized social factors and in-come based needs of the people living within India's most critical turtle habitats.

Furthermore, the program is positively affecting five endangered turtle species, the Red-crowned roof turtle (*Batagur kachuga*), the Three-striped roof turtle (*Batagur dhongoka*), the Indian river terrapin (*Batagur baska*), the Indian narrow-headed Softshell turtle (*Chitra indica*) and the Crowned River Turtle (*Hardella thurjii*).

However, we still need to expand our efforts to include the Assam roof turtle (*Pangshura sylhetensis*), the Black softshell turtle (*Nilssonia nigricans*), the elongated tortoises (*Indotestudo elongata*), Leith's softshell turtle (*Nilssonia leithii*) and the Asian giant softshell turtle (*Pelochelys cantorii*).

Recently we identified five important turtle conservation regions to implement the recommendations of action plan more efficiently and effectively (Plate 13 G). These areas are the Chambal region in North-Central India (including the Yamuna and upper Ganges River), the Terai region in North India, the states of West Bengal and Orissa in East India, the Assam region in Northeast India, and the Western Ghats in Southern India (Kerala and Karnataka).

The new vision of the program is to ensure the establishment of at least five wild self-sustaining populations and five captive assurance colonies for each endangered turtle species in next ten years.

We hope that our regional actions will not only help conserve the flagship turtle species (such as *Batagur kachuga*) (Plate 13 I) but also other endangered turtles and their associated habitats. These are small steps in a forward direction to protect India's waterscapes and their enigmatic inhabitants.

The program is gratefully supported by growing number of agencies like Turtle Survival Alliance, Turtle Conservation Funds, Disney Worldwide Conservation Fund, Beneficia foundation, San Diego Zoo's Institute for Conservation Research, Nature's Own, Cleveland Metro parks Zoo and Cleveland Zoological Society, EAZA Shellshock, British Chelonia Group, Pat Koval and WWF Canada, Rufford Small Grant Foundation, Sedgwick Zoo and plethora of volunteers and regional and local conservation organizations in different project areas.

The conservation program team members are Brian D. Horne, Shailendra Singh, Rishikesh Sharma, Ashutosh Tripathi Nikhil Whitaker, Bhasker M. Dixit, Rupali Ghosh, Chittaranjan Baruh, Khem B. Bhadauria, Pradeep K Saxena, Bikas K Saha and Suresh Pal Singh. The valuable partners of the turtle conservation program are Uttar Pradesh, Madhya Pradesh, Rajasthan, West Bengal, Assam state Forest Departments, Centre for Environmental Education, Terai Environmental Foundation Gharial Conservation Alliance, Development Alternatives, Lucknow University, BBAU Central University in Lucknow, Guwahati University, Katarniaghat Foundation, and Nature Exploration Group.

Plate 13



(A)



(B)



(C)



(D)



(E)



(F)



(G)



(H)



(I)

(A): A male of Red-crowned Roof Turtle, *Batagur kachuga*; it is estimated that less than four hundred adult females survive in Chambal River; (B): An in-situ turtle hatchery on the Chambal River; every year thousands of hatchlings are released from these hatcheries; (C): An energy and water efficient turtle headstarting adjacent to the Chambal National Sanctuary has been recently completed; (D): Local village children performing a skit based on the conservation challenges faced by the wildlife in the Chambal National Sanctuary; (E): Newly hatched *Chitra indica* awaiting release at in-situ hatchery on Ganga River; (F): A “turtle-poacher rehabilitation meeting” is in progress in the Terai region; such workshops help to convince poachers to engage in alternate livelihood practices rather than continue turtle poaching; (G): Map showing different regional turtle project areas; Red dots showing the current project sites while the green dots showing the proposed sites; (H): Our “Mobile Conservation Education Unit” on a camel cart during a rally along the sanctuary and (I): River Terrapin (*Batagur baska*), the most endangered Indian turtle, only 12 individuals are known to exist in captivity. Photos By: A: Rick Hudson; B, E: Ashutosh Tripathi; C, D, F, H, I : Shailendra Singh

Chapter 14

Illegal Trade of Fresh Water Turtles and Tortoises in India

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Introduction

Asian freshwater turtles in particular, and turtles in general, are facing increasingly severe threats that need to be dealt with effectively. Nearly 100% of Asian freshwater turtle and tortoise population is impacted by trade (Rhodin and Behler, 2001). Over half of Asian freshwater turtle and tortoise species are endangered as per the IUCN criteria. This includes 18 critically endangered, and one extinct species: the Yunnan box turtle *Cuora yunnanensis*. Asian chelonians are threatened due to habitat destruction, scale deforestation (Altherr and Freyer, 2000), chemical pollution and fragmentation of large rivers by dams (Altherr and Freyer, 2000). The international illegal trade in chelonians has additionally enhanced the problem and has been implicated as the major conservation threat for most species of Asian turtles (van Dijk *et al.* 2000).

The turtle fauna in India is represented by 33 species, which includes twenty-four freshwater, five marine and four land-dwelling species. India has three endemic turtles. Two of these — the Travancore tortoise (*Indotestudo travancorica*) and the Cochin forest cane turtle *Vijayachelys silvatica*), are endemic to the Western Ghats; while the Leith's softshell turtle (*Nilssonia leithii*) is endemic to peninsular India.

Two main types of trade in turtles occur in Asia. One is a high-volume, commodity-type trade in whole live turtles or turtle parts for consumption; the other is the pet trade.

Hunting of turtles for sustenance might have a less impact, but the growing demand in turtle plastron in China for making gelatin has up scaled the hunting to an unsustainable level. The high income from turtle plastron has attracted other communities to this trade, other than those who were engaged traditionally in hunting turtles.

A medium sized freshwater adult turtle yields approximately 500 g of meat, 300 g of carapace and other body parts and 200 g of plastron. In a single week long hunting period in a good turtle habitat, approximately 90 turtles are hunted, which could yield 18 kg of plastron. Such hunting practices are carried out four to five times in a month for about seven to eight months starting at the monsoon season in the gangetic river system. An operative of Trade Monitoring Unit was informed that the Gangetic soft shell turtle (*Nilssonia gangetica*) and the Common soft shell turtle (*Lissemys punctata*) is the most preferred turtle species amongst the buyers (O'Brien 2004).

We investigated the volume of trade in Indian Star Tortoise, *Geochelone elegans*, which is commonly used in the pet trade. In addition, we also investigated the principal states from where other fresh water chelonians are illegally hunted in India.

Methods

Since there is no recent primary information in India on chelonian trade, we relied on two secondary sources to derive national level information. Information collected since January 2001 is presented in this paper.

1. Information received through Forest department state offices in states where chelonian trade is reported. Records of number of turtles confiscated by either the forest department directly, or by the police department and handed over to the forest department, were collected. This source could provide information only on the number of chelonians seized with no/little reference to species or other details. Seizures were largely made in the same state that the chelonians were captured in. Therefore this data is thought to represent the approximate location of actual captures at the state level.
2. Information on turtle and tortoise seizures as reported in national daily newspapers were collected. For the star tortoise, the location of capture of the animals was always unknown. Therefore only information on numbers seized is presented here to illustrate the volume of trade. This is an unknown fraction of the total trade and no effort was made to correct this for actual numbers traded since this is unknown.

The Gangetic softshell turtle *Nilssonina gangetica* and the Indian flapshell turtle *Lissemys punctata* were reliably identified by the forest department officials and from the photographs in the newspaper articles. This paper provides a general view on trade and attempts to show how large and widespread is the trade in chelonians in India. The information pertains to the data collected from January 2001 – January 2004.

Results

Volume of trade in star tortoise

Between January 2001 and January 2004, 13 cases of star tortoise seizures from three international airports and two additional locations accounting for 7404 tortoises were reported in national newspapers. The airports at which seizures occurred were Anna International Airport, Chennai (64.4% of the tortoises), Changi International Airport, Singapore (27%), and Kuala Lumpur International Airport, Malaysia (7%). Two catches in Bangalore accounting for 120 tortoises were seized at a railway station and at an undisclosed location. Most cases have been after July 1, 2003 (Plate 14.2 A).

Distribution of chelonian trade in India

Between January 2001 and February 2004, a total of 43 records were collected from Forest Department staff and newspapers reports accounting for seizure of 4665 turtles and tortoises. These seizures were spread over 13 states with most seizures being from Uttar Pradesh, Andhra Pradesh, Jharkhand and Bihar, in that order (Plate 14.2 B). Apart from live and dead turtles, turtle carapaces and meat were also traded and have been seized in huge quantities at several places. Table-1 shows the diversity of chelonian trade in different states.

Table-1: Variety of use of chelonians as evidenced by seizures during trade in various states in India. (? – possible use but not confirmed; blanks do not indicate total absence of that product in trade but lack of information.)

State	Products			
	Meat	Carapace and related products	Live (for meat)	Live (for pet trade)
Andhra Pradesh	+		+	
Assam			+	
Bihar			+	
Delhi				+
Jharkhand			+	
Madhya Pradesh		+		
Manipur			+	+
Nagaland			+	
Rajasthan	+		+	?
Tamil Nadu			+	?
Uttar Pradesh		+	+	?
Uttaranchal			+	
West Bengal	+	+	+	

Discussion

Tortoises and freshwater turtle species continue to be threatened by fragmentation, destruction and pollution of their habitats. They are being hunted and traded in overwhelming numbers. They are used for food, pets and traditional medicine with no room for sustainability.

Among all the threats that the turtles and tortoises face today, the most serious of them is the uncontrolled trade for food and traditional medicine in south Asia. A large part of this trade is meant for markets in south-east Asian.

Reports of hunting and trade in turtle species show that the illegal hunting takes place in almost all water bodies such as irrigation canals, rivers and ponds. There is a definitive pressure on the turtle populations is evident from the fact that the communities are traveling large distances as the number of turtles is diminishing.

The three preferred species were the Gangetic soft shell turtle *Nilssonina gangetica*, the Indian flapshell turtle *Lissemys punctata* and the Peacock soft shelled turtle *Nilssonina hurum*. All the three species are listed in Schedule – I of the Wildlife (Protection) Act, 1972.

Recent studies conducted by TRAFFIC India in one of the prominent markets in Indonesia and Thailand indicate that the Indian Star Tortoise rank in top three of the most commonly traded species of tortoises. South India appears to be the hub of trade of star tortoises to transport the animals, and it appears to cater almost entirely to the international pet trade market. Reports in newspapers based on interrogations of the traders caught with the animals seems to indicate that most tortoises are acquired from Andhra Pradesh and transported to Tamil Nadu to be exported to the foreign market. The star tortoise is reported to be traded at a price ranging from US\$40 in Singapore to up to US\$150 in USA and Europe (O'Brien, A. 2004). Exports are mainly to the south-east Asian countries, Jakarta, Singapore and Bangkok. The total numbers of Asian turtles traded specifically as pets are difficult to estimate (Altherr and Freyer, 2000) and this paper provides the first information of actual numbers, albeit geographically scattered and incomplete. Incomplete records maintained by authorities at the location of seizures make it difficult to obtain complete details of the species involved in trade. We suggest that a standard questionnaire be distributed to officials at airports and sea ports and other transit points of trade. This should be reviewed periodically and information be shared to strengthen the knowledge base on trade in species. Translation of this information into policy can ensure control of the illegal trade of the species.

There is no information on the volume of trade of chelonians in India. This is serious gap in information considering that most experts acknowledge that India is the source for many species, particularly those sought for their meat, in the markets of entire southeast Asia (Altherr and Freyer, 2000), turtle meat is sold at prices varying from ' 5 to ' 100 depending on the species. Live softshell turtles are reportedly sold for ' 100 to ' 200 (O'Brien, 2004).

Newspaper reports severely underestimate the actual volume of trade. Therefore, field studies that quantify the volume of trade and its impacts are required in India. The state of Uttar Pradesh is known to be a source for most of the softshell turtles (Das 1990, Bhupathy *et al.*, 1992) and is corroborated by this study as well. The state needs to curb poaching and illegal trade. Regular reporting of catches to media by police and forest department is important. It conveys the magnitude of illegal trade in freshwater turtles and tortoises to the people and increases awareness.

Acknowledgements

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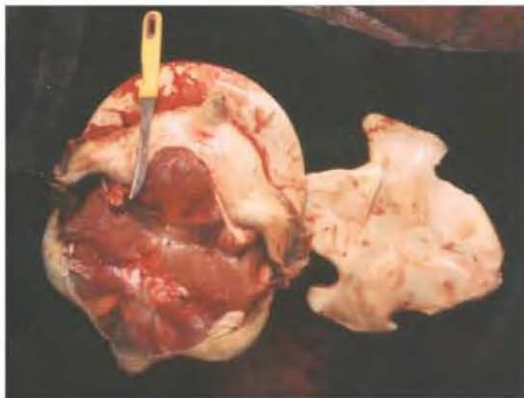
Plate 14.1



(A)



(B)



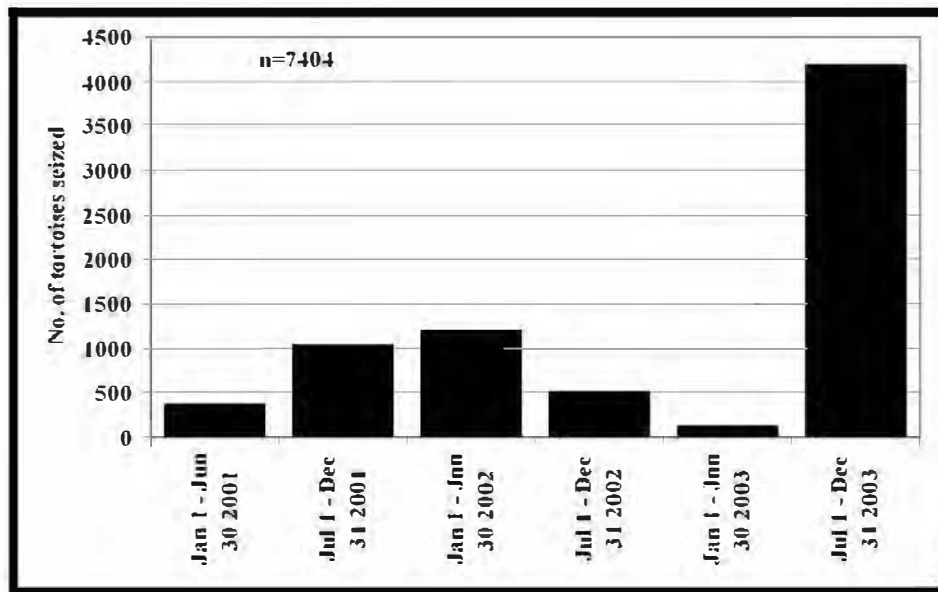
(D)



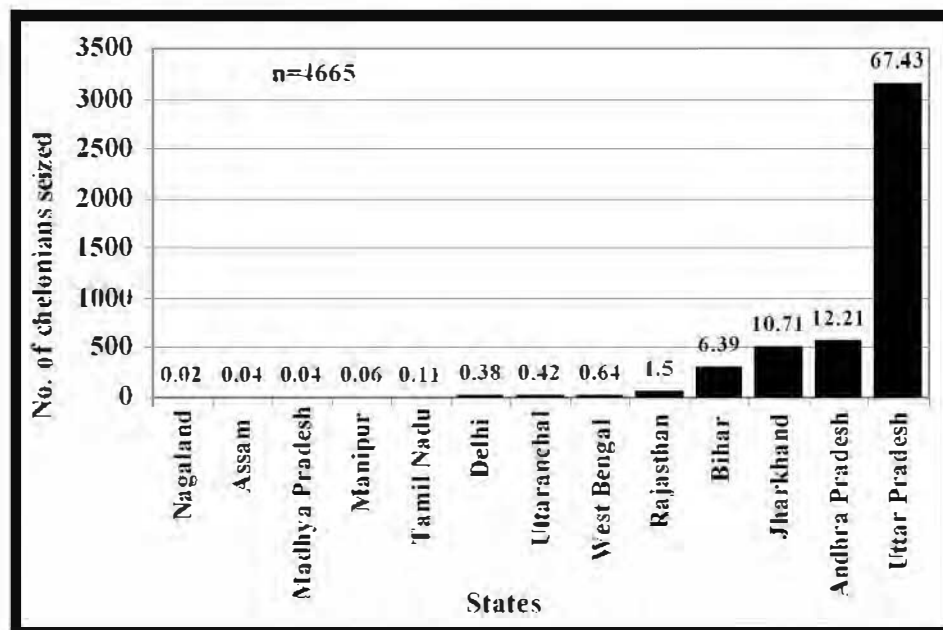
(E)

(A): Dismembered soft shell turtle with parts valuable in trade being removed; (B): Cartilaginous parts of the plastron of soft shell turtle used in trade; (C): Plastron of soft shell being excised and (D): *Nilssonina* sp. in trade.

Plate 14.2



(A)



(B)

(A): Number of Indian star tortoises in the pet trade as evidenced by seizures since Jan 1, 2001 and (B): Bias in number of chelonians seized in different states in India (Jan 1, 2001 – Feb 29, 2004).

Chapter 15

The Diversity, Ecology and Conservation Management of Freshwater turtles in Ganges River System

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Introduction

Freshwater turtles in India inhabit different water bodies ranging from shallow ponds to deep lakes and rivers. The Ganga River is a major river in India, which is a home for different species of aquatic animals including freshwater turtles. In addition major tributaries of the Ganga River including Chambal, Yamuna, Ken, Son, Ghagra, Girwa and Ramganga also hold different species of turtles. Few studies conducted on Indian freshwater turtles have mainly dealt with taxonomy and their broad distribution ranges (Smith 1933; Pritchard 1979; Daniel 1983; Das 1985; Tikader and Sharma 1985). Data on demographic and life histories of Indian turtles are limited (Rao 1982; Moll 1984). Rao (1990 and 1995) and Pandit (1997) contributed significant knowledge on the ecological relationships among few turtles in the Chambal River and in the Ganga River. The lack of scientific information on life history, bio-ecology and populations of turtles has been considered as one of the pressing problems to devise management strategies for turtles in the field. In India large numbers of turtles were slaughtered in different states for consumptive utilization. Due to lack of restrictions on the capture of turtles and little or no enforcement of existing legislation, populations of turtles in different water bodies are decreasing (Moll, 1984). The steady decline in populations of different species of freshwater turtles in different river systems in India has prompted research and conservation programmes on freshwater turtles in different parts of India (Moll, 1984; Rao, 1990; Choudhury and Bhupathy, 1993). The National as well as International scientific and conservation community has therefore declared a number of turtles as endangered in the Schedules of Indian Wildlife (Protection) Act, 1972 and in the Red Data List (IUCN 2010; Rao, 1989).

Looking into the success of the crocodile conservation project in India, where populations of all three species of crocodiles are highly protected, turtles living in similar aquatic habitats could also be conserved effectively. This paper deals with species diversity and major conservation issues for turtles in Ganges River system India.

Surveys were conducted in the Ganga River and Chambal River, a major tributary in the Ganges River system to collect information on turtle species diversity, habitat characteristics, species utilization, conservation status *etc.* Identification of the specimens was done by following the keys given by Smith (1933), Pritchard (1979), Daniel (1983) and Das (1985).

Ganga River

The Ganga River rises at 7010 meters in Gangotri, Uttarkashi District, Uttarakhand, India on the southern slopes of the Himalayan Range. It flows through four different States – Uttarakhand, Uttar Pradesh, Bihar and West Bengal covering a distance of 2525 km where large number of tributaries joins the Ganga River before the river joins the Bay of Bengal. The Ganges river system in India is considered as most productive and important river system. The information presented in the paper was collected from the upper stretch of the river in the Uttarakhand and in the Uttar Pradesh after the river starts flowing in the plains at Rishikesh to Kanpur. The total length of the river in this stretch is 645 km. The entire river stretch under study is shallow with only intermittent small stretches of deep water pools and reservoirs upstream barrages. There are four barrages constructed on the river. They are at Rishikesh, Haridwar, Bijnor and Narora. Large amount of water is being diverted from the river for varied purposes, mainly for irrigation. The river is considered as a holy river, so during different festivals large numbers of people take bath and perform rituals in the river. The Ganga river, including the study area, has been under constant threat of pollution due to various human activities like sewage and industrial wastes disposal, dead bodies disposal, deforestation, excessive use of fertilizers and pesticides, bathing, pilgrimage and water development programmes.

Chambal River

The Chambal River, one of the best remaining habitats for the gharial in its range, originates in the Vindhyan range near Mhow in Madhya Pradesh. It flows in a northeastern direction, passing through Rajasthan up to Pali and thereafter it flows in eastern direction, forming the boundary of M.P. and Rajasthan and M.P. and Uttar Pradesh. It joins the Yamuna River near Bareilly of Etawah District of U.P. The Yamuna, in turn, flows in a southeast direction, till it meets the Ganga River at Allahabad. Kali Sindh, Parbati, Banas and Kuno are the important tributaries of the Chambal River. A series of multipurpose dams at Gandhi Sagar (M.P.), Rana Pratap Sagar (Rajasthan), Jawahar Sagar (Rajasthan) and Kota barrage (Raj.) have been erected in the upper reaches of the Chambal River.

National Chambal Sanctuary

During 1978 the Chambal River was declared as a Crocodile Sanctuary under Crocodile Project with an aim to provide fully protected habitat for conservation and propagation of gharial crocodilian and other wild animals. The National Chambal Sanctuary extends over the Chambal River from Jawahar Sagar Dam to Kota barrage and after a gap of 18 km free zone, from Keshoraipatan (Raj.) through Pali to Pachanada (U.P.) where Kunwari, Pahuj and Sindh rivers form a confluence with the Yamuna River. The total length of the river inside the sanctuary is about 600 km. The width of the river that is included inside the sanctuary is 1000 m from either bank in Rajasthan and Madhya Pradesh. Uttar Pradesh has a greater width totaling to an area of 635km². Geographically, the sanctuary lies between the latitude 25° 35' N and 26° 52' N and longitude 76° 28' E and 79° 01' E.

Species Diversity

India is bestowed with a great variety of Chelonian fauna. There are 24 species of freshwater turtles, 4 species of tortoises and 5 species of marine turtles. The distribution of freshwater turtles in India was not known clearly until a country wide survey was conducted during late 1980's (Moll, 1984). With the increase in the interest on Chelonian studies, now large number of locality records of different species is available. The occurrence of different species of freshwater turtles in various Biogeographic zones identified by Rodgers and Panwar (1988) and in different states is shown in Tables-1 and 2. Each State in the country holds at least one species of turtle with maximum number of 17 turtle species in the State of West Bengal (77.3%).

The freshwater turtle diversity in different rivers of the Ganges river system is almost similar with minor changes. There are more than 12 species of freshwater turtles in habit in these rivers. In the Upper Ganga River, a total of 12 species of freshwater turtle species have been identified. The list of turtle species is given in Table-3. The *Pangshura* sp. are dominated with 3 species (*Pangshura smithii*, *P. tecta*, *P. tentoria*), followed by two species each of *Nilssonina* (*N. gangetica* and *N. hurum*) and *Batagur* (*B. dhongoka* and *B. kachuga*) one species each of *Chitra indica*, *Lissemys punctata*, *Hardella thurjii*, *Geoclemys hamiltoni* and *Melanochelys trijuga*.

Table-1: Data showing occurrence of turtle species in different Biogeographic Zones

S.No.	Biogeographic Zone	No. of Species	Percentage
1.	Trans Himalayas	0	0
2.	The Himalayas	17	77.2
3.	The Indian Deserts	2	9.1
4.	Semi Arid Zone	10	45.5
5.	Western Ghats	5	22.7
6.	Deccan Peninsula	10	45.5
7.	The Gangetic Plains	14	63.6
8.	The North Eastern Zone	15	68.2
9.	Andaman and Nicobar Islands	2	9.1
10.	The coastal region	10	45.5

Table-2: Data showing occurrence of different turtle species in various States and Biogeographic Zones in India.

S.No.	Species	No. of States	Percentage	No. of Biogeographic Zones
1.	<i>Cuora mouhotii</i>	7	28	1
2.	<i>Cyclemys gemeli</i>	3	12	2
3.	<i>Cuora amboinensis</i>	3	12	3
4.	<i>Vijayachelys silvatica</i>	3	12	1
5.	<i>Melanochelys tricarinata</i>	6	24	3
6.	<i>Melanochelys trijuga</i>	11	44	6
7.	<i>Geoclemys hamiltonii</i>	9	36	6
8.	<i>Morenia petersi</i>	4	16	3
9.	<i>Hardella thurjii</i>	10	40	6
10.	<i>Pangshura smithii</i>	8	32	4
11.	<i>Pangshura tecta</i>	14	56	6
12.	<i>Pangshura tentoria</i>	12	48	7
13.	<i>Pangshura sylhetensis</i>	4	16	2
14.	<i>Batagur dhongoka</i>	5	20	3
15.	<i>Batagur kachuga</i>	9	36	3
16.	<i>Batagur baska</i>	2	8	1
17.	<i>Lissemys punctata</i>	20	80	9
18.	<i>Pelochelys cantorii</i>	3	12	1
19.	<i>Chitra indica</i>	11	44	5
20.	<i>Nilssonia gangetica</i>	11	44	5
21.	<i>Nilssonia leithii</i>	7	28	3
22.	<i>Nilssonia hurum</i>	10	40	6
23.	<i>Nilssonia nigricans</i>	2	8	1
24.	<i>Amyda cartilaginea</i>	2	8	1

Table-3: List of freshwater turtle species in the Ganges river system and their conservation status.

S.No.	Species	Rivers	Conservation Status		
			WLPA	CITES	IUCN
1	<i>Melanochelys trijuga</i>	G	NL	NL	LR
2	<i>Geoclemys hamiltonii</i>	G	SI	AI	VU
3	<i>Hardella thurjii</i>	G,C	NL	NL	VU
4	<i>Pangshura smithii</i>	G	NL	AII	NT
5	<i>Pangshura tecta</i>	G	SI	AI	LR
6	<i>Pangshura tentoria</i>	G,C	NL	AI	LR
7	<i>Batagur dhongoka</i>	G,C	NL	AII	EN
8	<i>Batagur kachuga</i>	G,C	SI	AII	CE
9	<i>Lissemys punctata</i>	G,C	SI	AII	LR
10	<i>Nilssonia gangetica</i>	G,C	SI	AI	VU
11	<i>Nilssonia hurum</i>	G	SI	AI	V
12	<i>Chitra indica</i>	G,C	SII	AII	E

G: Ganga River, C: Chambal River

WLPA: Indian Wildlife Protection Act, 1972; CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora; IUCN: International Union for Conservation of Nature and Natural Resources (World conservation Union)

NL: Not Listed, S: Schedule, A: Appendix, VU: Vulnerable, LR: Low Risk, NT: Near Threatened

EN: Endangered, CE: Critically Endangered

Threats

In India turtle populations have declined drastically during the last few decades as a result of direct and indirect human interventions. Illegal and over exploitation have caused an alarming state for turtles. To meet the demand, freshwater turtles from different rivers of the northern states of India are illegally caught and exported to various markets in the north-eastern states. Soft-shell turtles particularly, *Nilssonina gangetica*, *N. hurum*, *Chitra indica*, *Lissemys punctata* are most commonly sold due to their tender flesh and more meat yield per animal. *Batagur kachuga*, *G. hamiltoni*, and other large hard-shell turtles are also sold in the markets.

Loss of turtle eggs due to predation by man, domestic and wild animals, and other abiotic factors are the main factors for population decline of turtles. The water development projects in India are serious threats to the freshwater turtle population. The dams and barrages on the rivers mainly affect the natural riverine habitats of the turtles. Natural discharge of rivers is altered by the construction of dams. Additional important factors are conversion of river banks into agricultural fields and collection of sand from nesting sites (Rao 1990, 1995).

Species depletion

In the Ganga River depletion of populations of turtle species was mainly due to habitat loss and over-exploitation.

a. Habitat loss:

The riverine habitat of freshwater turtles in the Ganga River is under constant threat due to many human activities like construction of barrages, agriculture practices on the river banks, discharge of pollutants *etc.* The notable among them are water development projects which alter the natural flow of the river. Barrages constructed on the Ganga river made the flowing water habitat stagnant upstream of the barrages. In the downstream less water flows. Intensive agriculture practices on the river banks have resulted in the decline of suitable nesting sites for turtles. Due to the rapid urbanization and industrialization on the river banks large amount of domestic, industrial and agriculture pollutants are reaching the river. The pollution in the river is a major threat to the aquatic animals including turtles as the food chain is affected.

b. Exploitation

Freshwater turtles in the Ganga river are used for food and medicinal purpose. Locals in the bank-side villages, fishermen and other turtle poachers frequently catch large number of turtles. The large turtles particularly, the soft-shell turtles, *Geoclemys*, *B. kachuga* and *B. dhongoka* are highly used by the locals for food. During fishing operations small turtle species, mostly *Pangshura* spp. die in fishing nets. The fishermen intensively fish in the river, using various types of nets. Small turtles get entangled in the nets and die due to drowning.

Conservation

Out of the 12 species of turtles identified from the study area 6 species are considered as endangered and categorized in Schedule I of the Indian Wildlife (Protection) Act, 1972. Although the turtles were protected through legislation, the laws are not effective in the field. Exploitation of turtles is still continued. Due to human population increase need for exploitation of natural resources is also very much increasing. The continued exploitation of turtles and degradation of habitat is alarming.

a. Religious protection

The turtle occupies an honored place in many mythologies. The turtles and tortoises are considered as religious symbols. According to Hindu mythology, the Universe is supported by four elephants standing on a turtle's back. People show special reverence to the turtle as they consider the turtle as a one of the ten main incarnations of 'Vishnu', the supreme God. River Yamuna, mythologically called as 'Mother Yamuna' used the turtle as her 'vahan' (vehicle) (Rao, 1987). All these superstitions gave good protection to the turtles. In addition, the river stretches at major pilgrimage centers are protected by local people where they perform rituals. These river stretches are good habitats for large number of turtles. Such river stretches can be referred as 'Religious Sanctuaries' for the protection of turtles.

b. Legislation

In India, laws are legislated under Wildlife (Protection) Act, 1972 to save the endangered species from illegal poaching and give protection to their habitat. To control any illegal International trade many of the endangered species are included in Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Indian chelonians are also given protection through National as well as International

legislation (Rao, 1987; Choudhury and Bhupathy, 1993). The total number of species included in Indian Wildlife (Protection) Act (IWPA) and CITES are given in Table-3.

c. Incidental protection

Freshwater turtles in India receive incidental protection in different sanctuaries specially created for crocodile conservation started since 1975. Populations of crocodiles have been protected in 34 protected areas in which 13 areas have been specially created as crocodile sanctuaries. Stopping of fishing activity, maintaining full protection from poaching, extending protection to habitat and rehabilitation of captive reared crocodiles are the management strategies adopted in different crocodile sanctuaries (Rao, 1992). Protection staff posted in the sanctuaries and in other protected areas keeps regular vigil to stop illegal capturing of crocodiles and also other animals like turtles. In this way turtles receive incidental protection in different crocodile areas.

The aquatic fauna in the Chambal River is protected as the river is under the management of National Chambal Sanctuary. Aquatic life in some stretches in the Ganga River is protected as these stretches receive protection from the religious people on the river ghats. The National Chambal Sanctuary, specially declared as Gharial sanctuary in the year 1978, has contributed much for the Biodiversity conservation. Regular monitoring revealed that populations of different turtles species in the Chambal River are in good number in comparing with the populations in the Ganga River. If the National Chambal Sanctuary is taken as an example of protecting aquatic animals in the Chambal River, then at least one or two sanctuaries should be created in the upper stretch of the Ganga River for turtle conservation.

Conclusion

In recent years there has been growing awareness of the need for positive conservation action for chelonians. Unfortunately, there are still major gaps in our knowledge of the ecology, distribution and status of many of the rarer and endangered species. This makes conservation planning more difficult. Some Indian turtle species are endangered for clearly defined reasons, while others are feared to be in trouble because of their restricted ranges or habitat specialization. Efforts have to be made to formulate suitable action plan for conservation of turtles in India. The goal to get the right kind of support for turtle conservation is being achieved by creating awareness of the importance of turtle fishery among the public. If the people realize that turtle resources are managed primarily for a common benefit then only would they co-operate in conservation and rationally utilize the turtle resources.

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Chapter 16

Turtle Diversity in the Sacred Temple Ponds in Kamrup District of Assam with Special Reference to its Conservation

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Introduction

The Northeast India along with eastern Himalaya forms a mega diversity area and is regarded as one of the major centres of turtle diversity. Turtles of the world are represented by 314 species/subspecies and 95 Genera (Anonymous 2007a) of which 17 species, belonging to 3 families are recorded in northeast India (Das 1988). According to Hindu mythology turtles are an incarnation of Lord Vishnu (Anonymous 2003). Since time immemorial this incarnation has been worshipped in many of the ancient temples of Assam, where turtles have historically received protection in temple tanks like Hayagriva-Madhava temple at Hajo, Kamakhya temple and Ugra Tara temple at Guwahati, Shiva temple at Tinisukia etc. (Shanker and Kutty 2005). This “religions approach” is directly linked with conservation, through which a few rare turtles have gained protection (Anonymous 2007b). This form of Chelonian conservation in temple tanks constitutes a useful method for ensuring their conservation. Our investigation was designed to evaluate the status, distribution and analysis of certain physiochemical parameters of two ponds of historical temples in Kamrup district of Assam (India).

Study Site

Hayagriva Madhava Temple

It is situated on the Monikut hill near Hajo, which is approximately 25 km away from Guwahati, the Capital city of Assam. The geographical location is 26°14'25.49" N - 91°33'57.62" E with an altitude of about 602m above the sea level. The climate of Hajo is humid sub-tropic with an annual average rainfall of about 1200 mm. The average minimum and maximum air temperature is recorded 12°C and 37°C respectively. The relative humidity is around 80%. The temple was constructed by the King Raghu Deva Narayan in 1583. At the foot of the stairway is a large pond known as Madhab Pukhuri which is inhabited by a number of turtles. This pond is about 1.3 ha.

Kamakhya Temple

It is one of the famous Shakti shrines in India, and is regarded as one of the **Shakti Peethams** associated with the legend of **Shiva** and **Daksha Yagna**, which is situated high aloft a hill called Neelachal Parbat in the city of Guwahati. The geographical location is 26°09'55.32" N - 91°42'15.93" E with an altitude of about 629m above the sea level. The King Nara Narayan of Cooch Behar rebuilt the temple in 1665, after it had suffered destruction at the hands of foreign invaders. About 25 m downhill of the Kamakhya temple, there is a pond known as Kacha Pukhuri (Plate 16 A). This Kacha pukhuri is located at a height of 160 m above sea level, which serves as the home to soft shell turtles. This pond is about 0.2 ha.

Ugrotara Temple

The Ugrotara temple is one of the famous Shakti shrines dedicated to Goddess Tara (Devi), situated near Jor Pukhuri at the heart of Guwahati city. The geographical location is 26°11'20.53" N - 91°45'13.35" E with an altitude of about 190 m above the sea level. The climate is humid with an annual average rainfall of about 1600 mm. The average minimum and maximum air temperature is recorded 19.2°C and 36°C respectively. The relative humidity is around 89%. Jor Pukhuri (Plate 16 B), which is at the rear end the temple, covering an area of about 0.4 ha has turtles.

Methodology

The preliminary survey was conducted during the period of October 2007 to March 2008. The survey was done in three temple ponds following the Visual encounter survey (VES) and local people interrogation using photo sheet and from indirect evidence such as the presence of food items specific to softshell turtle species (Goswami, 2004; Verlecar and Desai, 2004). Identification of the species was followed after Das (1995). The study area was censused one to three times per day between 7:30 a.m. to 5 p.m. by VES and interviewing local people.

Physiochemical parameter such as dissolved oxygen was estimated using modified Wrinkler's method (Trivedy *et al.*, 1987); free Carbon dioxide was calculated by titration method of Jhingran and Pullin (1988). Transparency of the water was determined by using the Secchi disc method (Preisendorfer, 1986); pH was measured by using Systronic digital pH meter (Table-1); zoo and phyto plankton were identified following the methods of Goswami (2004) and Verlecar and Desai (2004) (Table 2). The estimation was carried out daily from 0600 to 0700 h.

Table-1: Analysis of certain parameters of water of study sites.

Study sites	Months	Dissolved O ₂ (mg/L)	Free CO ₂ (mg/L)	Transparency (cm)	pH
Madhab Pukhuri	October	12.5	9.5	35.5	6.7
	November	12.8	9.2	30.0	6.8
	December	12.2	9.4	34.0	6.7
	January	12.6	9.2	32.0	6.9
	February	12.2	8.4	33.5	6.8
	March	12.9	9.6	35.1	6.8
	Mean	12.5±0.27	9.22±0.39	33.35±2.06	6.78±0.08
Kacha Pukhuri	October	10.6	6.0	41.5	6.6
	November	10.4	5.8	42.5	6.4
	December	10.3	5.6	42.1	6.4
	January	10.4	5.9	41.9	6.5
	February	10.8	6.0	41.0	6.5
	March	10.7	6.1	41.2	6.4
	Mean	10.5±0.20	5.9±0.16	41.7±0.57	6.47±0.08
Jor Pukhuri	October	10.4	5.0	41.1	6.2
	November	10.4	5.1	42.5	6.4
	December	10.3	5.0	42.1	6.2
	January	10.5	5.0	41.5	6.1
	February	10.5	5.0	41.0	6.1
	March	10.6	5.1	41.7	6.1
	Mean	10.5±0.10	5.0±0.05	41.7±0.52	6.18±0.12

Table-2: List of Planktons recorded in study sites.

Planktons	Group	Study sites		
		Madhab Pukhuri	Kacha Pukhuri	Jor Pukhuri
Phytoplanktons	Chlorophyceae	+++	+	+
	Bacillariophyceae	++	-	-
	Cynophyceae	++	+	++
	Xanthophyceae	++	+	+
	MYXOPHYCEAE	++	+	+
Zooplanktons	ROTIFERS	+	+	+
	Copepoda	++	+	+
	Cladocera	+	+	+
	Protozoa	+	+	++
	Arthropods	++	+	+

(+) indicates increasing levels of abundance; (-) indicates absence.

Results

During the study period a total of six species were observed in both the ponds, out of which six were observed in Madhab Pukhuri, two in Kacha Pukhuri and one in Jor Pukhuri.

Results

During the study period a total of six species were recorded at Madhab Pukhuri of which three species viz. *Geoclemys hamiltonii*, *Pangshura tectum* and *Pangshura tentoria* belonging to the family Geoemydidae (Plate C, D and E) and the rest three *Nilssonina gangetica*, *Nilssonina nigricans* and *Nilssonina hurum* of Trionychidae family (Plate 16 F, G and H). *Nilssonina nigricans* and *Nilssonina hurum* were most abundant followed by *Geoclemys hamiltonii*. Some individuals of *N. nigricans* seemed to be old with excessive coating of algae on their shells. The planktonic study revealed that the green algae viz. *Spirogyra protecta*, *Spirogyra maxima*, *Microspora sp.*, *Pendaoirina morum*, *Volvox* were observed in large numbers in the water. Among the zooplanktons *Cyclops*, *Daphnia*, *Nauplius*, *Euglena*, Crustacean larvae, etc. were recorded.

On the other hand *Nilssonina nigricans* and *Nilssonina hurum* were observed at Kacha Pukhuri of Kamakhya, but their population was lesser here than in Madhav pukhuri. Similarly phyto and zooplankton were also recorded in much lesser numbers. However, large number of *Oreochromis mossambica* and a few *Clarius gariepinus* fish species were observed.

Discussion

Dissolved oxygen can impact many physical and biological factors in water body. The DO content of Madhab Pukhuri was observed higher (12.5 mg/L) compared to Kacha Pukhuri (10.6 mg/L). The presence of a healthier turtle population in the Madhab Pukhuri might be due to greater levels DO. The free carbon dioxide content of our investigation in both the ponds was within acceptable limits. This might have a positive effect on the growth of planktons and might also sustain the turtle population (Smith and Griffiths, 2000).

Transparency of water in Madhab Pukhuri (33.5cm) and in Kacha Pukhari (45.6cm) was within acceptable limits (Paraschag and Gemel, 2002).

Presently the turtle populations in the Madhab Pukhuri are under threat due to construction of a concrete boundary. This will damage the only nesting area available for the turtles. Secondly, it will encourage the visitors to come to the edge of the pond and feed food items to turtles. This might affect nutrient cycling in the pond. Similar phenomenon was also observed in the Kacha Pukhari of Kamakhya temple but the main threat observed here is the presence of the fish species, *Clarius gariepinus*. Since this fish species is highly carnivorous in nature therefore, it might compete with the turtles for food. Jor Pukhuri also witnessed the construction of concrete border.

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Plate 16



(A)



(B)



(C)



(D)



(E)



(F)



(G)



(H)

(A): Kacha Pukhuri ; (B): Jor Pukhuri; (C): *Geoclemys hamiltonii*; (D): *Pangshura tectum*; (E): *Pangshura tentoria*; (F): *Nilsonnia gangeticus*; (G): *Nilsonnia nigricans* and (H): *Nilsonnia hurum*

Chapter 17

Freshwater Turtles of India: Status and Management in Captivity

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Introduction

Freshwater wetlands are home to a diverse assemblage of flora and fauna – both microbial and macro. Chelonians are one such group which has made freshwater rivers, lakes, ponds and estuaries their home. Chelonians are by far the most ancient quadruped vertebrates on earth and India is home to a large and diverse assemblage of this order (Das, 1985; 1995; 2002; Das and Andrews, 1997). It ranks among the top five Asian countries in terms of its importance for turtle conservation (Stuart and Thorbjarnarson, 2003). Twenty eight species of tortoises and freshwater turtles have been reported from the Indian subcontinent. Unfortunately, nearly 40% (11 of 28 species) are listed as either Endangered or Critically Endangered on the IUCN Red List. Three of these 28 species of tortoises and turtles, the *Indotestudo travancorica* (Travancore Tortoise), *Nilssononia leithii* (Deccan Softshell turtle) and *Vijayachelys silvatica* (Cochin Forest Cane Turtle) are endemic to India. Northeast India has the largest species diversity with 24 species. The Indo-Gangetic plain and the Terai region also has a diverse chelonian fauna with the occurrence of 20 species (Das, 2002; Rao, 1990). Species richness and diversity in India has both national and global significance.

The ever-increasing human pressures on turtle habitats such as sand mining, agriculture, reclamation of wetlands and riparian areas, alteration of rivers for irrigation and generation of hydroelectric power, pollution, siltation, eutrophication, and intensive fishing have not only taken a heavy toll of turtle biomass, but also have disrupted nesting and reproduction. In northeast India, tortoises get burnt alive during controlled burning of grassland in some protected areas. Several freshwater turtles are still directly exploited for both local consumption and export, (Choudhury and Bhupathy, 1993). This has decimated turtle populations and threatened them with extinction. Although several species receive protection in PAs there have been few concerted efforts to conserve Indian chelonians or breed them in captivity.

Scanty information on ecology and biology of Indian turtles is available (Moll, 1984). Extensive field surveys for the identification and studying the ecology of freshwater turtles were conducted by Rao (1990) As part of the Ganga Action Plan, the Government of India supported a rearing and release programme of the Uttar Pradesh Forest Department. Under this programme two turtle rehabilitation centres were established in the state; one at Sarnath, Varanasi and the other at Kukrail, Lucknow. The Ganges River System, between 1985 and 1993, was restocked with over 40,000 captive reared turtles. However this included only *Nilssononia gangetica* to clear corpses and carcasses from the river, and the project came to a premature end due to lack of funds.

There is an increased awareness on the need for conservation action for protection of freshwater chelonians. However, major gaps exist in our knowledge of the ecology and behaviour, distribution and status, taxonomy and identification of sexes of this increasingly threatened group. Ex-situ studies can provide the bridge to these gaps, especially in behaviour, taxonomy and identification of sexes.

The status of various freshwater turtles of India in captivity in Indian zoos was accessed from information of the Central Zoo Authority of India (cza.nic.in) website. The sections discussing management in captivity and status in wild have been drafted after a review of available literature. *Vijayachelys silvatica*, *Melanocheilus tricarinatus* and *Cuora mouhotii* have not been included here.



Results and discussion

Conservation Status freshwater turtles

Freshwater turtles occupy a variety of habitats from rivers, freshwater lakes and ponds to brackish water and estuaries. Each of these habitats is exploited differently by man and accordingly turtles are under varying degree of threats. Table-1 below summarizes the Wildlife Protection Act Status and the IUCN Red List status and criteria for inclusion. Eighteen of the 21 species of freshwater chelonians currently found in India are under varying degree of threats, they are listed both, in the different schedules of the WPA and IUCN Red List or in either one of them.

Table-1: Conservation status of Indian freshwater turtles.

Sl. No.	Species	Common name	WPA Status	IUCN Red List Status and Criteria
1.	<i>Batagur baska</i>	River Terrapin	Schedule 1 Part II	Critically Endangered A1cd
2.	<i>Batagur kachuga</i>	Red Crowned Roofed Turtle	Schedule 1 Part II	Critically Endangered A1cd
3.	<i>Chitra indica</i>	Chitra Turtle	Not listed	Endangered A1cd+2cd
4.	<i>Batagur dhongoka</i>	Three Striped Roofed Turtle	Not listed	Endangered A1cd+2cd
5.	<i>Pangshura sylhetensis</i>	Assam Roofed Turtle	Not listed	Endangered B1+2c
6.	<i>Pelochelys cantorii</i>	Cantor's giant softshell turtle	Not listed	Endangered A1cd+2cd
7.	<i>Nilssonia nigricans</i> *	Black Softshell turtle	Not listed	Possibly extinct in the wild, However recent reports indicate the presence in north-east Assam
8.	<i>Nilssonia gangetica</i>	Indian/Ganges Soft-shelled Turtle	Schedule 1 Part II	Vulnerable A1d+2d
9.	<i>Amyda cartilaginea</i>	Asiatic Softshell Turtle	Not listed	Vulnerable A1cd+2cd
10.	<i>Nilssonia hurum</i>	Peacock Soft shelled Turtle	Schedule 1 Part II	Vulnerable A1cd+2d
11.	<i>Nilssonia leithii</i>	Deccan Softshell Turtle	Not listed	Vulnerable A1c
12.	<i>Cuora amboinensis</i>	Malayan Box Turtle	Not listed	Vulnerable A1d+2d
13.	<i>Geoclemys hamiltonii</i>	Spotted Black Terrapin	Schedule 1 Part II	Vulnerable A1d+2d
14.	<i>Hardella thurjii</i>	Brahminy Terrapin	Not listed	Vulnerable A1cd+2cd
15.	<i>Morenia petersi</i>	Indian Eyed Turtle	Not listed	Vulnerable A1cd+2d
16.	<i>Cyclemys dentata</i> , <i>Cyclemys oldhamii</i>	Asian leaf turtle	Not listed	Low risk/ near threatened
17.	<i>Pangshura smithii</i>	Brown Roofed Turtle	Not listed	Low risk/ near threatened
18.	<i>Melanochelys trijuga</i>	Indian Pond Terrapin or Black Turtle	Not listed	Low risk/ near threatened
19.	<i>Pangshura tecta</i>	Indian Roofed Turtle	Schedule 1 Part II	Low risk/ least concern
20.	<i>Pangshura tentoria</i>	Indian Tent Terrapin	Not listed	Low risk/ least concern
21.	<i>Lissemys punctata</i>	Indian Mud or Flap Shell Turtle	Schedule 1 Part II	Low risk/ least concern

Status in captivity

The status of freshwater turtles in captivity in various Indian zoos is provided in Table-2. A perusal of the table suggests that most of the turtle species are poorly represented in Indian zoos with skewed/undetermined sex ratios. Accordingly the breeding of these turtle species, several of which are highly threatened is still poorer. Of a total of 21 freshwater turtle species only 7 are represented in captivity besides this there were 143 specimens in captivity which could not be identified.

Table-2: Status of freshwater turtles in Indian Zoos.

Sl. No.	Common Name	Species	No. of Zoos	Captive Population				
				Births	M	F	U	T
1.	Indian/Ganges Soft-shelled Turtle	<i>Nilssonia gangetica</i>	6	0	4	5	38	47
2.	Peacock Soft shelled Turtle	<i>Nilssonia hurum</i>	1	0	0	0	2	2
3.	Red Crowned Roofed Turtle	<i>Batagur kachuga</i>	1	6	0	0	14	14
4.	Indian Roofed Turtle	<i>Pangshura tecta</i>	3	0	5	9	2	16
5.	Indian Tent Terrapin	<i>Pangshura tentoria</i>	3	0	1	1	4	6
6.	Indian Mud or Flap Shell Turtle	<i>Lissemys punctata</i>	17	2	51	33	306	390
7.	Indian Pond Terrapin or Black Turtle	<i>Melanochelys trijuga</i>	8	0	12	19	55	86
8.	Red Eared Terrapin**	<i>Trachemys scripta elegans</i>	2	0	4	1	798	803
9.	Unidentified Turtles	Unidentified turtle species	16	0	18	31	94	143

M: Male, F: Female,

U: Unsexed and

T: Total

** The species is not a native of India and individuals in captivity probably owe their presence to confiscated animals as the species is common in the pet trade.

Freshwater turtles in captivity with reference to their IUCN Red List status are presented in Plate 17 A. It may be inferred that species which are in urgent need of ex-situ conservation efforts are poorly represented whereas species which at lower risk are relatively more abundant.

Status of information available on biology and ecology of freshwater turtles

The biological and ecological information collected from various sources available for freshwater turtle species occurring in India is summarized in Table-3. The table suggests that while some baseline information is available for most of the species critical gaps remain for most of the species. Information on age of maturity and life spans are noticeably missing for all the species. Information on reproduction, breeding seasons and rearing protocols for juveniles is lacking for several species.



Table-3 Information available on habitat preferences and biology of freshwater turtles

S.N	Species	Habitat preference	Food preference	Nesting areas	Breeding Season	Clutch Size	Incubation period
1.	<i>Batagur baska</i>	Tidal areas of estuaries of large rivers	Mainly herbivorous; plant material at lower salinities, but also eats mollusks, crustaceans and fish	Communal nesting on sandbars in the tidal zone	Mating; prior to and beginning of monsoon. Nesting late December to early March	5 – 60 eggs	68 – 112 days
2.	<i>Batagur kachuga</i>	Large deep flowing rivers	Herbivorous	—	Nesting in March – April	15 – 30 eggs	Exact duration not known, hatchlings appear in May or June
3.	<i>Chitra indica</i>	Clear sand bottom stretches of large rivers	Mainly carnivorous; fish, snails, shrimps, mollusks and some amount of plant material	Sand or sandy loam	Nesting from August to mid September	65 – 187 eggs	—
4.	<i>Batagur dhongoka</i>	Large deep rivers	Herbivorous, may occasionally eat snails	Sand banks	Nesting from March to April	16 – 35 eggs	Exact duration not known, hatchlings appear in May - June
5.	<i>Pangshura sylhetensis</i>	Rivers and oxbow lakes with emergent macrophytic vegetation	Omnivorous; plant parts of emergent macrophytic vegetation, aquatic invertebrates and fish	—	—	—	—
6.	<i>Pelochelys cantorii</i>	Freshwater streams and deep slow moving rivers, brackish coastal waters, captures have also been reported from sea	Omnivorous; aquatic invertebrates, fish and aquatic plants	—	Nesting February – March	20 – 28 eggs	—
7.	<i>Nilssonina nigricans</i>	Temple pond in Bangladesh	—	Earth banks	Feb – May	6-38 eggs	96 – 104days
8.	<i>Nilssonina gangetica</i>	Any large, deep and turbid water body	Omnivorous; mollusks, insects, fish, amphibians, waterfowl and carrion	Sand banks	Mating during Monsoon Nesting from May to January, with a peak in December to January	8 – 47 eggs	251 – 310 days
9.	<i>Amyda cartilaginea</i>	Both upland and lowland streams, ponds and swamps	Carnivorous; fishes, amphibians, crustaceans, aquatic insects and other invertebrates.	Mud banks	No fixed breeding season	5 – 7 eggs 3 – 4 times a year	135 – 140 days
10.	<i>Nilssonina hurum</i>	Rivers, streams, ponds and lakes with mud or sand bottom	Carnivorous; snails, insects and fish	—	Nesting in winter	—	—

S.N	Species	Habitat preference	Food preference	Nesting areas	Breeding Season	Clutch Size	Incubation period
11.	<i>Nilssonia leithii</i>	Reservoirs shallow stretches of rivers and streams with mud or sand bottom	Carnivorous; aquatic invertebrates, fish, amphibian tadpoles and some plant material	—	—	—	—
12.	<i>Cuora amboinensis</i>	Water bodies with soft bottoms and slow currents	Herbivorous		Nesting takes place April - June	1 -5 eggs; 2 - 4 clutches	—
13.	<i>Geoclemys hamiltonii</i>	Shallow water bodies with slow current and dense vegetation	Carnivorous; aquatic invertebrates, fishes and amphibian larvae	Mud banks	Monsoon – from may – October	26 – 36 eggs 2 clutches per season	~74 days
14.	<i>Hardella thurjii</i>	Shallow water bodies with slow current and dense vegetation	Herbivorous; aquatic plants	Sandy soil	Mating April – July, Nesting August – September	14 – 19 eggs	—
15.	<i>Morenia petersi</i>	Slow moving rivers, ponds and swamps	Omnivorous	—	Mating in winter nesting from April - May	2 eggs	—
16.	<i>Cyclemys dentata</i> / <i>Cyclemys oldhamii</i>	Shallow streams in both mountains and lowlands	Omnivorous	—	—	2 -4 eggs per clutch and 4 – 5 clutches each year	—
17.	<i>Pangshura smithii</i>	Rivers and large canals with muddy water	Omnivorous; plants, crustaceans and occasional scavenging	Sand banks	Nesting August to mid-September	3 – 11 eggs	—
18.	<i>Melanochelys trijuga</i>	Ponds, streams and rivers with clean water	Herbivorous; may occasionally scavenge	Eggs have been recovered from grassland latrines of rhinoceros	Throughout the year	3 – 6 eggs	60 – 65 days
19.	<i>Pangshura tecta</i>	Soft bottom, sluggish streams, canals and oxbows, also reported from coastal brackish waters	Omnivorous; it also scavenges	—	Mating and nesting during October to march	3 – 14 eggs, may lay two clutches in each season	70 – 144 days
20.	<i>Pangshura tentoria</i>	Rivers	Mainly herbivorous but occasionally take animal food		Egg laying October to November	3 - 10 eggs	-
21.	<i>Lissemys punctata</i>	Shallow stagnant waters with soft bottom	Omnivorous; frogs, fishes, aquatic invertebrates and plant material	Loamy soil near swampy areas where sunlight is available	Nesting from September to November (June – October) Western India	34 – 40 eggs, 2 -3 clutches each year	241 – 409 days



It is recommended that adult turtles be captured from the wild and maintained in captivity. The number of captive individuals can be increased by collecting eggs from the wild and rearing them in captivity. While collecting eggs or collecting eggs from the wild care must be taken to ensure that they come from different locations. This would maximize genetic diversity of the founder population.

All individuals should be appropriately marked at the time of their entry into captivity (all eggs should also be marked and as hatchlings emerge these should also be marked). Detailed records for all individuals in captivity on location of capture/egg collection, parentage details, behavioural patterns, reproductive history and records of all health care interventions should be maintained. These records should be used to plan mating between individuals. The ex-situ program should be strongly linked to the in-situ conservation efforts and be targeted to produce surpluses for reintroduction/ restocking wherever appropriate. All reintroductions/restockings should be carried out in consonance with relevant IUCN guidelines and should have a well defined post-release monitoring program.

Selection of species for conservation breeding and display needs to be prioritized based on the conservation status of species. Those having greater threat perception should receive high priority for ex-situ programs. The selected sites for initiation of such programs must be within the natural range of the occurrence of the species. Accordingly (Table-4) species have been ranked in order of their threat perception and suitable sites are suggested for establishment of ex-situ facilities.

Table-4: Distribution of Freshwater turtles in India and suggested centers for ex-situ conservation.

Species	Distribution (States)	Existing zoos/ conservation breeding centres to initiate ex-situ conservation
<i>Batagur baska</i>	AP, OA	Establishment of a breeding centre in Sunderbans
<i>Batagur kachuga</i>	MP, RJ, PU, UP, BH, WB	Kukrail, Lucknow and Deori, Morena
<i>Chitra indica</i>	TN, AP, OA, MP, MH, RJ, PU, UP, BH, WB, AM	Madras Crocodile Bank Trust, Kukrail, Lucknow and Deori, Morena
<i>Batagur dhongoka</i>	MP, RJ, UP, BH, WB, AM	Kukrail, Lucknow and Deori, Morena
<i>Pangshura sylhetensis</i>	WB, MG, AM, AR, NG, MZ	Assam State Zoo, Gauhati
<i>Peleochelys cantorii</i>	TN, KL, OA, WB,	Madras Crocodile Bank Trust, Nandankannan Biological Park, Bhubaneswar
<i>Nilssonia nigricans</i>	AM	Assam State Zoo, Gauhati
<i>Nilssonia gangetica</i>	OA, MP, GJ, RJ, HY, PU, JK, UP, BH, AM, MN	Kukrail, Lucknow and Deori, Morena
<i>Amyda cartilaginea</i>	MZ	Establishment of a breeding centre in Mizoram
<i>Nilssonia hurum</i>	OA, MP, MH, RJ, UP, NH, WB, AM, AR, MN	Nandankannan Biological Park, Bhubaneswar, Kukrail, Lucknow and Deori, Morena
<i>Nilssonia leithii</i>	TN, KL, KA, AP, OA, MP, MH, UP	Madras Crocodile Bank Trust, Kukrail, Lucknow and Deori, Morena
<i>Cuora amboinensis</i>	AM, AR, NG, MN	Assam State Zoo, Gauhati and Manipur Zoological Garden, Imphal
<i>Geoclemys hamiltonii</i>	KL, RJ, PU, JK, UP, BH, WB, AM, AR	Madras Crocodile Bank Trust, Kukrail, Lucknow and Deori, Morena
<i>Hardella thurjii</i>	MP, RJ, PU, UP, BH, WB, MG, AM	Kukrail, Lucknow and Deori, Morena
<i>Morenia petersi</i>	UP, BH, WB, AR	Kukrail, Lucknow and Deori, Morena
<i>Cyclemys dentata</i>	WB, MG, AM, AR, MN, MZ	Assam State Zoo, Gauhati and Manipur Zoological Garden, Imphal
<i>Pangshura smithii</i>	PU, JK, UP, BH, AM	Assam State Zoo, Gauhati, Kukrail, Lucknow and Deori, Morena
<i>Melanochelys trijuga</i>	TN, KL, KA, AP, MH, GJ, HP, UP, BH, WB, SK, MG, AM	Madras Crocodile Bank Trust and Kukrail, Lucknow
<i>Pangshura tecta</i>	OA, MP, MH, GJ, RJ, PU, JK, UP, BH, WB, MG, AM, AR, MZ	Kukrail, Lucknow, Nandankannan Biological Park, Bhubaneswar and Deori, Morena
<i>Pangshura tentoria</i>	OA, MP, MH, GJ, RJ, UP, BH, WB, AM, AR, MN, MZ	Kukrail, Lucknow, Nandankannan Biological Park, Bhubaneswar and Deori, Morena
<i>Lissemys punctata</i>	TN, KL, KA, GA, AP, OA, MP, MH, GJ, RJ, HY, PU, JK, UP, BH, WB, SK, MG, AM, AR	Madras Crocodile Bank Trust, Kukrail, Lucknow and Deori, Morena

Species ranked in order of conservation status; Selection of on basis of range of occurrence and the presence of captive breeding facilities/zoos in those areas.

AM=Assam; AP=Andhra Pradesh; AR=Arunachal Pradesh; BH=Bihar and Jharkhand; GA=Goa; GJ=Gujarat; HP=Himachal Pradesh; HY=Haryana; JK=Jammu and Kashmir; KA=Karnataka; KL=Kerala; MG=Meghalaya; MH=Maharashtra; MN=Manipur; MP=Madhya Pradesh and Chhattisgarh; MZ=Mizoram; NG=Nagaland; OA=Orissa; PU=Punjab; RJ=Rajasathan; SK=Sikkim; TN=Tamil Nadu; TR=Tripura; UP=Uttar Pradesh and Uttaranchal; WB=West Bengal; *Distribution states - source: Choudhury et al., 2000, Bhupathy and Menon, 2003*

Captive Management

The few existing programs (e.g., Deori Gharial Center at Morena, Madhya Pradesh Kukrail Gharial Breeding Center at Lucknow, Uttar Pradesh and Madras Crocodile Bank at Mammalapuram, Tamil Nadu), some of which while achieving important breakthroughs such as the record captive breeding of *Batgaur kachuga* at the Madras Crocodile Bank and at Kukrail, were modest in scope. These limited captive breeding efforts restricted to few species were on a scale unlikely to exert a measurable impact on the recovery of wild turtle populations. There needs to be a shift in the focus of these programs on a select number of species in captivity, rearing and reintroducing them into wild to maintaining viable *ex-situ* populations of all species with appropriate housing. The focus should be on managing genetically viable and demographically stable populations that can produce surpluses for reintroduction. All reintroduction efforts should be made in consonance with IUCN guidelines and initiated only when suitable habitats with adequate protection and post release monitoring protocols are in place.

Individuals entering an ex-situ conservation program will have to be managed intensively. Suitable enclosures that fulfill minimal requirements of the species have to be designed and constructed before bringing the species into captivity. A schematic layout of designs for enclosures for display (Plate 17 B) and conservation breeding (Plate 17 C) respectively are given. Designs will change according to the species and location. While designing enclosures care must be taken to ensure that they simulate the naturalistic conditions to a large extent. This will allow the captive individuals to maintain their behavioral repertoire of natural behaviours essential to their survival in the wild. Sanitation, health care also needs consideration while designing the enclosures. Water filtration units with sufficient capacity, should be installed with each enclosure to maintain water-quality and reduce water-borne infections to which all chelonians are susceptible. Turtles in captivity are susceptible to shell rot and enteric disorders in captivity. Good sanitation such as removal of leftover food and continuous circulation of clean water in the ponds will go a long way in maintaining hygiene in the enclosure.

The sides of the enclosures should be vermin proof and the tops should be covered with wire mesh to prevent the entry of predators. The ponds should have a gradual incline on the sides to facilitate turtle entry and exit from the ponds. The centre of each pond should be of adequate depth depending on the species housed. The enclosures should be exposed to direct sunlight for atleast a part of the day to allow basking and also for sex differentiation during hatching of eggs. Each species has a unique nesting requirement. Based on this nest sites with adequate depth and type (Sand/Mud) can be provided in the enclosures. The enclosures should have elevated platforms that are easily accessible for basking and display. Besides this the turtles should have hiding places like crevices for hiding from conspecifics. Similarly the feed being provided and the depth of the water body needs to be monitored on a regular basis.

Turtles are voracious and versatile feeders. In order to have a clear understanding of the quantity required initially ad-libitum feed should be provided and gradually reduced till no feed is leftover. This can then be taken as the optimum quantity of feed. Diets should be as close to food preferences in free ranging counterparts, because these animals are being targeted for reintroduction. Surrogate feed should only be provided when natural feeds are not available. The feeding regime should be developed to provide a complete balanced diet to all individuals in captivity. The feeding protocol should be formulated based on the physiological needs, growth needs and maintenance needs. For all species having carnivorous food preferences live prey should be provided wherever possible. The animals would retain the instinct of predation and the presence of live prey would be a stimulant to express naturalistic behaviours in captivity. It is essential that appropriate supplements are provided along with the feed as in captivity access to natural feeds is restricted and balanced nutrition through diets alone cannot be ensured. It is pertinent to mention here that the feeds being provided should be periodically tested for nutrient quality, microbial load and contaminants if any.

Conclusions

Rapidly expanding human population, large scale changes in land use/landcover, burgeoning development projects and improper use of watersheds have all caused a substantial decline of wetland resources of the country. This has resulted in loss of crucial habitats for several faunal types, prominent among which are freshwater turtles. India has a documented species richness of 24 species of freshwater chelonians of which 18 have varying threat perceptions. Large gaps still remain in our knowledge of the biology and ecology of most species. In view of this, it is recommended that species that are under threat in the wild be intensively managed

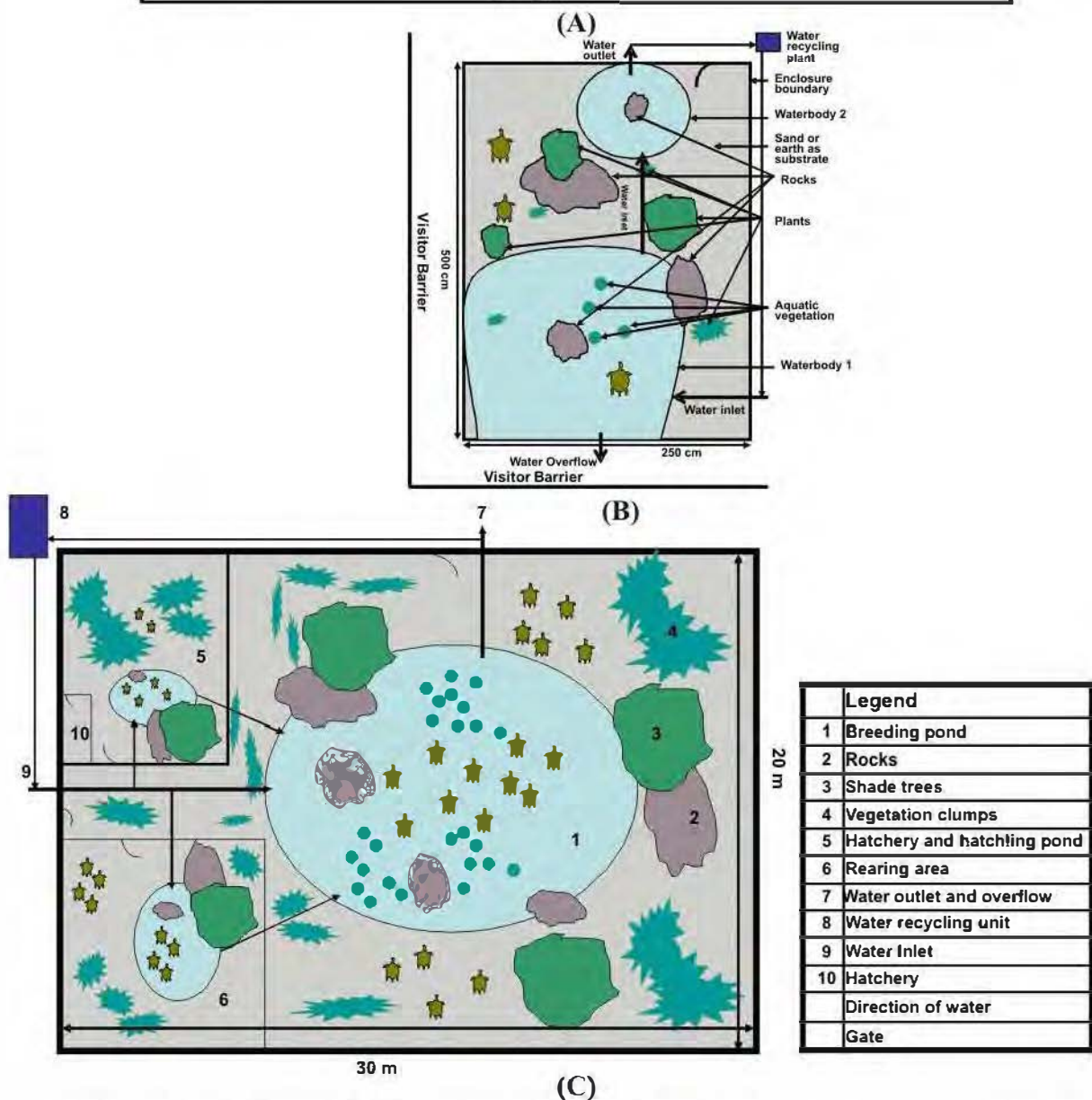
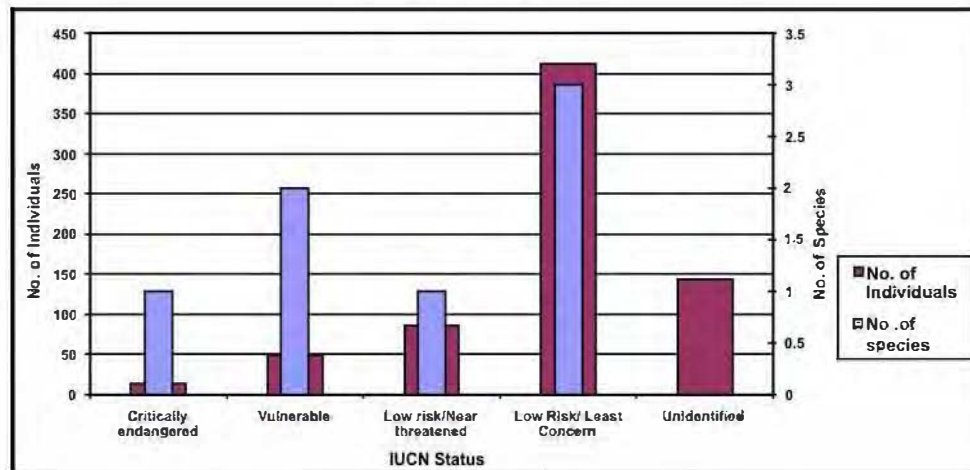


in a program with dynamic *in-situ* – *ex-situ* linkage. Conservation breeding centres in existing zoos or new facilities may be established within their natural ranges and the program be targeted for producing surpluses. Besides producing surpluses for reintroduction such a program would provide crucial information on the biology and ecology of the species.

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Plate 17



(A): Status of Freshwater Turtle in Captivity; (B): An enclosure design for exhibiting six freshwater turtles up to 30 cm in size (not to scale) and (C): An enclosure design for breeding and rearing freshwater turtles for ex-situ management (not to scale)

Chapter 18

Captive Breeding of the Critically Endangered Red-Crowned Roof Turtle *Batagur kachuga* (Gray 1831) at the Madras Crocodile Bank Trust

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Introduction

The Red-crowned roof-turtle, *Batagur kachuga*, has been identified as in critical need of both in-situ and ex-situ conservation action (CFH/MCBT 2006). Threats were, and continue to be, illegal sand mining (which destroys nesting banks), net-fishing, and consumption for food. This species is listed under Schedule I of the Wildlife (Protection) Act, 1972, and under Appendix II of CITES.

The Madras Crocodile Bank Trust (MCBT) entered into an agreement with the Uttar Pradesh Forest Department (UPFD) for an ex-situ program, wherein a group of the species was to be collected from this state and transferred to MCBT, with an agreement that 50 % of progeny produced at MCBT would be sent back to Uttar Pradesh for reintroduction.

The MCBT received 2 male and 4 female *B. kachuga* in June 2001 from the Kukkrail Gharial Rearing Centre at Uttar Pradesh. Animals were placed in woven baskets and transported by train with keepers from MCBT accompanying them. These animals upon arrival were separated into small ponds to assess hydration status. They were quarantined for 6 months, before introducing them to a larger group of existing chelonians, namely *Melanochelys trijuga* and *B. dhongoka*.

Enclosures

Initial quarantine enclosures for adults had perimeter walls measuring 3.8 m, with 2 square water bodies measuring 1.2 x 1.2 m. Substrate on the land was sand and bushes, namely *Pandanus* and shade grass. Subsequently in September 2001, the adult animals were transferred to a large temple turtle pond measuring 29.5 x 15.2 m, with a maximum depth of 2.7 m leading up to a shallow gradient.

Hatchlings were housed in a pen measuring 4 x 2.9 m with a perimeter wall, and a 1.5 m oval water body. Once they grew out of these ponds, they were transferred to enclosures connected to a gravel bed filtration. Perimeter walls of these 2 enclosures measured 10 x 3m with a water body measuring 9 x 2.6 meters, and varying depths ranging from 300 mm to 50 mm. A 30 x 30 mm gap nylon mesh was draped on the ceiling to avoid avian predation. In 2009, hatchlings are maintained in glass aquariums measuring 1.2 x 0.8 x 0.8 m and a square land area, with fish bio-filters (Body Guard™ AP2200F) where they will remain for ca. 2 months until they grow. Comparisons between a freshly hatched *B. kachuga* (55 g) and a 2 month old animal (118 g) under these conditions is given in (Plate 18.1 A).

Diet

Local availability of a large number of spinaches, cashew fruits, beans, carrots, tomatoes, ensured good nutrition to these animals. Food was also supplemented with soya balls and cuttle fish bones adhibition. In 2008 – 2009 additional supplements were commercially available turtle feed, details of which are given in Table-1. A locally available succulent grass was also supplemented to hatchlings and breeders.

Egg collection and incubation

In the 2009 nesting season, efforts were made to locate nests as soon after laying as possible. Thus, the nesting mound was swept every evening, and checked for turtle tracks the next morning. Location of nests was confirmed by probing the general area where sand and leaf litter had been thrown on surrounding bushes, logs, etc. (Plate 18.1 B) with a long metal probe.

Once located, nests were collected and the eggs were processed, which initially involved marking the upper most horizontal surface of the egg with an "x". Subsequently, candling for sub-embryonic fluid visible in viable eggs (Webb and Manolis 1987) (Plate 18.1 C), and recording lengths, widths, and weights of each egg occurred. Eggs were then assigned a unique number with a Sharpie™ marker, and placed in plastic boxes with moist sand from the nest as a substrate. Holes drilled for ventilation in the egg boxes were covered with a small bud of cotton to prevent ingress of fruit flies. In addition, a half bottle of beer was placed in the cabinet holding the boxes, with a piece of raw meat at the bottom, as described by Wolff (2007), to ward off hump-backed flies. All incubation occurred in a closed wooden cupboard, which prevented problems with rats attacking the eggs. Some clutches were monitored with HOBO Tidbit devices, and details of incubation temperatures are given below.

Husbandry and identification

In all the 4 pens holding *B. kachuga* sub-adults, juveniles, and hatchlings, daily maintenance included frequent water changes (1 x/week), save for sub-adults and younger animals which were in ponds fitted with a gravel bed filtration system. The much larger breeding pen was drained once every 6 months at which point animals were measured. During routine captures/pond cleanings, animals were examined for abnormal lesions, palpitated for eggs, and measured. Some animals developed large amount of algae on the shells which was gently scrubbed off with tooth-brushes. The breeding pen was modified in 2008, with a large sand mound for nesting being constructed, and a significant amount of tree cover was opened up to encourage basking. Plastic mesh with 20 x 20 mm gaps was also embedded on sunlit areas to assist adults in hauling out to bask (Plate 18.1 D). This resulted in 50:50 ratio of sun and shade in this pen.

On 15th April 2009, all breeders were fitted with PIT tags, and these were also placed in the sub-adults from 2005 on 1st May 2009 when these animals were transferred to the breeding pond. This precluded the problem of traditional marginal scute clippings done for several years here, as scutes sometimes wear out and identification of animals became problematic, resulting loss of data of individual growth values.

Reproduction

Table-2 gives details of the clutches laid at MCBT between 2003 and 2009. A clutch of eggs were first discovered in 2003, but these were infertile. Between 2004 and 2009, there were between 1 and 5 clutches every year, save for 2006 when no nesting occurred. Eggs were collected in February – March of every year, except in 2004, 2008, and 2009 when nests were missed and hatching occurred naturally in the enclosure. The number of nests increased to 6 in 2009 at the MCBT. This indicated multiple clutching by females, probably due to improved husbandry conditions described above. An abdominal x-ray of MCBT female 0006F23F5E, taken on 15th April 2009, where apparently well shelled eggs are apparent (R. Hudson, S. Farrel, B. Horne, *pers comm.* (Plate 18.1 E). It may be of interest to note here *B. kachuga* have a pliable-shelled to hard expansible type shell as described by Ewert (1979). Several eggs collected were found to be cracked, but as long as the shell membrane remained intact these eggs usually incubated to term.

The nesting season at the MCBT is similar to Singh and Rao's (1985) observation wherein they noted the nesting season being from March to April on the Chambal River, U.P. Egg measurements and clutch sizes are similar to those reported by other authors. Moll (1986) measured 18 eggs from three nests and length averaged 71.6 mm, width 40.3 mm, and weight 51.8 mm. Clutch sizes of these nests ranged from 20 to 25. Singh and Rao (1985) examined 11 clutches and these had clutch sizes ranging from 11 to 30 (Mean = 18 eggs).

Courtship of adults was observed in September through October, probably remaining true to the natural range of the species in Northern India. The group of breeding animals at MCBT did not experience the major fluctuations experienced in their natural habitat, but lower temperatures could have been achieved by selecting deeper areas of the breeding pond.

Incubation period and temperatures

The range at which eggs incubated at ambient temperatures produced hatchlings was between 25.3 – 34.4°C, and these data are presented in Plate 18.1 F and 18.2 A and B. Eggs from clutches that had with sub-embryonic fluid within when collected took from 47 – 55 days to hatch. Generation of metabolic heat was evident from the third trimester of incubation. Early embryonic deaths were easy to ascertain, as banding typically became blotched.

One hatchling from Clutch 4-2009 died on 18th April 2009 of unknown reasons, and this was confirmed to be a female upon dissection and observation of oviducts.

Hatchling morphometrics

Measurements of hatchling *B. kachuga* are given in Table-3. There was little variation between and within clutches. Observations by other authors on hatchling sizes are similar, but not reported here (i.e. Singh and Rao 1985, Moll, 1986). Plate 18.2 C shows a freshly hatched *B. kachuga*, note the folded shell which expands within 24 hrs, whilst plate 18.2 D is a ventral view of a hatchling with a “yolk button”, these are usually internalized within 48 hrs. The umbilical scar lasts for about 14 days.

Growth rates of adults and juveniles

Upon arrival in June 2001, the 2 male *Batagur kachuga* averaged 231 mm plastron length (PL), and 2.95 kg. When measured on 15th April 2009, they averaged 241 mm PL, and weight averaged 3.45 kg. The females averaged 421 mm PL, and weight averaged 12.75 Kg. In April 2009, PL in these animals averaged 432.5 mm, and weight averaged 17.25 kg. As reproduction commenced in 2003, it is clear that the above figures represent sexual mature specimens. Some workers suggest that females may take much longer than males to mature, about 20 years (D. Basu, pers. comm.).

A sample of 6 hatchlings from 2007, animals collected from the breeding pond which still had yolk buttons, were chosen to represent growth data in this species. Whilst sample sizes are small, it is evident that animals grow out significantly, particularly at around 1.5 years old especially in terms of weight gain (Plate 18.1 E).

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Table-1: Details of the turtle feed used for rearing *Batagur kachuga* hatchlings/juveniles.

1	Ingredients	White, fish meal, shrimp meat, wheat flour, corn meal, yeast, enzyme, calcium, magnesium, biotin, Vitaman A, C, E, and other trace ingredients
2	Proximate analysis	Crude protein; 35 %, Crude fibre; 3 %, Crude fat; 4 %

Table-2: Clutch sizes, hatchlings, and egg/nest details of *Batagur kachuga* between 2003 – 2009 at the Centre for Herpetology.

Year	Clutch	Date eggs/hatchlings collected	CS	# Via	# H	X EL	X EW	X EM	Nest Depth	Nest Temp
2003	1*	21/3/03	11	0	-	-	-	-	-	-
2004	1*	3/5/04	-	-	19	-	-	-	-	-
2005	1*	-	16	-	13	-	-	-	42.5	-
2007	1*	28/4/07	-	-	6	-	-	-	-	-
2008	1	29/2/08	16	14	3	67.93	38.86	61.16	37.0	-
-	2	20/3/08	21	16	1	68.15	34.86	48.39	19.1	25.9
-	3*	11/4/08	-	-	5	-	-	-	-	-
2009	1	30/1/09	18	16	0	68.56	38.75	62.67	26.5	27.4
-	2	18/2/09	12	9	6	62.0	38.53	53.64	29.0	28.6
-	3	17/3/09	15	11	6	68.0	37.15	53.33	20.5	28.3
-	4*	15/4/09	-	-	9	-	-	-	-	-
-	5	18/4/09	23	21	7	62.15	37.90	51.86	29.0	31.2

- Whilst several clutches had a number of viable eggs, a minimal number hatched perhaps due to the absence of a calciferous layer on the eggs.
- # H is inclusive of hatchlings found in the breeding pond; these clutches therefore do not have egg morphometrics, and date refers to the date hatchlings were retrieved from the pond, clutches are marked *.
- The single clutch from 2005 was left to naturally incubate where it was found within a plastic-meshed enclosure after recording nest parameters.

Table-3: Morphometrics of hatchling *Batagur kachuga* produced during 2005 – 2009. CL; carapace length, CW; carapace width, PL; plastron length, Wt; weight.

(*indicates hatchlings were collected from breeding pond; average is followed by standard deviation).

Year-Clutch #	X CL (mm)	X CW (mm)	X PL (mm)	X Wt (gms)
2009-05 (n=7)	57.0 ±0.8 (55.7 – 57.9)	49.9 ±1.3 (48.6 – 52.3)	48.9 ±0.9 (47.8 – 50.0)	33.6 ±1.8 (31 – 37)
2009-04* (n=9)	57.5 ±1 (55.5-58.9)	49.4 ±1 (47.5 – 51.2)	49 ±0.9 (47.2 – 50.1)	32.5 ±1.4 (30 – 35)
2009-03 (n=6)	52.7 ±1.7 (50 – 54.5)	46.5 ±0.9 (45.6 – 48)	45.9 ±1.4 (44.4 – 48.2)	25.3 ±3.4 (21 – 30)
2009-02 (n=6)	55.5 ±2.2 (51.8-57.6)	48.6 ±2.9 (43.7 – 51.7)	48.2 ±2.2 (44.3 – 50.1)	31 ±1.9 (29 – 34)
2008-03* (n=5)	55.4 ±2.5 (51.5 – 58.1)	49.4 ±2.8 (44.5 – 51.6)	48.3 ±1.7 (45.4 – 49.8)	33.6 ±3.8 (27 – 36)
2005-01 (n=13)	55.4 ±1.5 (51.3 – 57.1)	47.1 ±4.7 (35.4 – 51.1)	48.2 ±1.7 (43.8 – 50.03)	-

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Plate 18.1

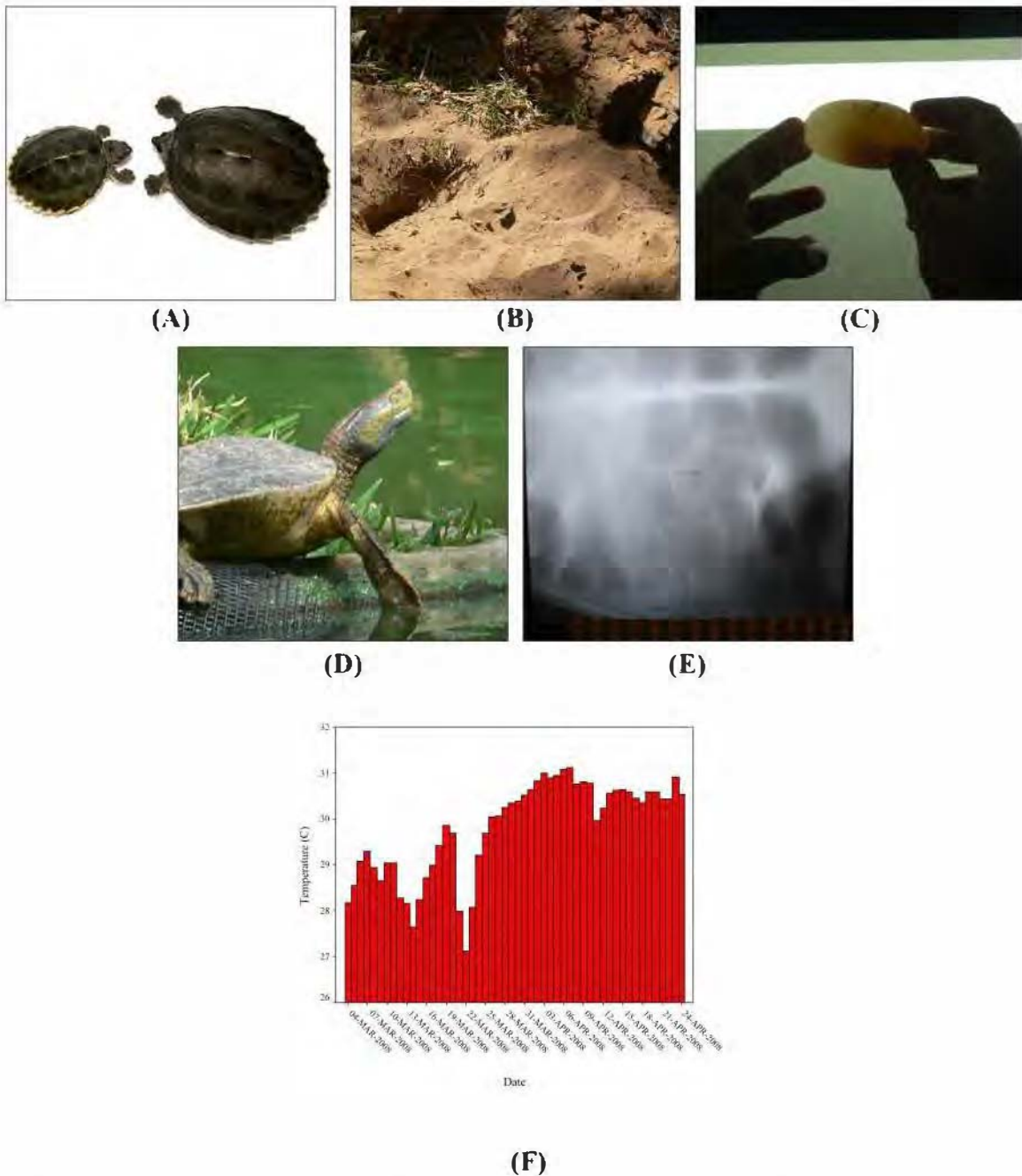
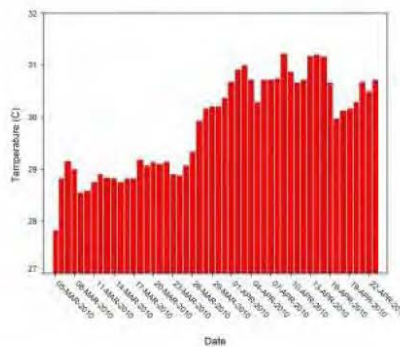
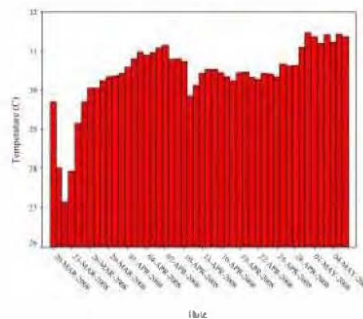
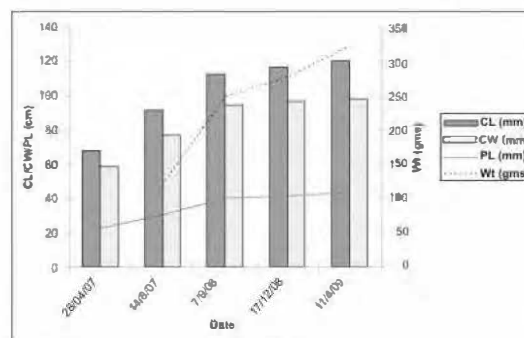


Plate 18.2



(C)

(D)



(E)

(A): Incubation temperature of *B. kachuga* Clutch 1-B, 2008. Nest was collected on 20th March 2008, and 1 egg hatched on 6th May 2008 after a laboratory incubation period of 47 days. Mean temperature was 30.4 ± 1.1 C (range 26.5 – 32.7 C); (B): Incubation temperatures of *B. kachuga* Clutch 6, 2010. Eggs were collected on 15th March 2010, with 18 eggs hatching on 22nd April, a total of 48 lab incubation days. Mean temperature was 29.9 ± 0.9 C (range 24.0 – 32.5 C); (C): Freshly hatched *B. kachuga* with folded shell; (D): Freshly hatched *B. kachuga* with a visible "yolk button" and (E): Growth rates of *B. kachuga* juveniles between April 2007 and April 2009 (n=6); CL = carapace length, CW = carapace width, PL=plastron length, Wt=mass. Weight was only measured from August 2007.

Chapter 19

Selected Bibliography on Freshwater Turtles and Tortoises of India

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Introduction

A large volume of scientific information on Freshwater Turtles is widely scattered in India. It would be difficult and critical to access appropriate and relevant literature on the subject due to in absence of proper documentation. This bibliography contains 392 references. This bibliography covers almost 155 years (1853-2009).

The following secondary sources have been consulted during the compilation of this bibliography:

- a) International Database
 - i) Wildlife and Ecology Studies (Period 1935 – 2009)
- b) WII Library and Documentation Centre in-house Databases
 - i) Reprint Database
 - ii) Book Database
 - iii) WILD Database (Indexing and Abstracting Database of Indian Wildlife)

To make bibliography more user friendly, the bibliography has been supplemented with four indices for easy access to the citations.

- a) The **Author** index
- b) The **Subject** index
- c) The **Publication year** index
- d) The **Taxonomic name** index

Each article in the bibliography has been analyzed on the basis of 16 broad subject headings as shown in Table 1. Among these **Distribution** followed by **Conservation and Management**, **Natural History** and **Reproduction** dominate the database.

S.No.	Subject	No. of References
1.	Distribution	116
2.	Conservation and Management	45
3.	Natural History	43
4.	Reproduction	28
5.	Ecology	28
6.	Status	25
7.	Captivity	25
8.	Behavior	22
9.	Wildlife Trade	16
10.	Techniques/Tools/Analysis	14
11.	Morphology	11
12.	Miscellaneous	10
13.	Taxonomy	9
14.	Habitat	5
15.	Population Studies	3
16.	Wildlife Health	2

A total of 296 authors have been indexed in the present bibliography and their contribution in-term of number of publication ranged from 1 to 36.

Further analysis of the database shows that 226 out of 392 references have been contributed individually, as shown in Table 2. Other 166 references were found to be contributed in collaboration.

Table 2: Authorship pattern.

S.No.	Authorship Pattern	No. of References
1.	Single	226
2.	Two	107
3.	Three	37
4.	Four	8
5.	Five	3
6.	Six	1
7.	Corporate Authors	2
8.	Anonymous	8
Total		392

Trend in the chronological development of literature has been shown in table 3. The number of publications in a year ranged 0-22 with the year 1998 recording the maximum publications (22).

Table 3: Chronological Development of literature.

S. No.	Period	No. of References
1.	1853-1969	12
2.	1970-1979	13
3.	1980-1989	104
4.	1990-1999	152
5.	2000-2009	111
Total		392

The above table also reveals that 263 (>67 %) references have been published from 1990 to 2009.

For the convenience of the user, this bibliography is also available in database form at the Wildlife Institute of India, Library and Documentation Centre. It is hoped that providing information both in traditional printed form as well as through machine readable database will be very useful and act as a ready reference to both professional and amateur wildlife ecologists and protected area managers, interested in the Freshwater Turtles of India. We would also like to add that this database is not complete. While all possible efforts have been made to cite the references as accurately as possible, it is probable that some mistakes have remained, largely owing to the compilation of the majority of references from secondary sources. We would be grateful if such mistakes are brought to our notice for correction and continuous updating of this database.

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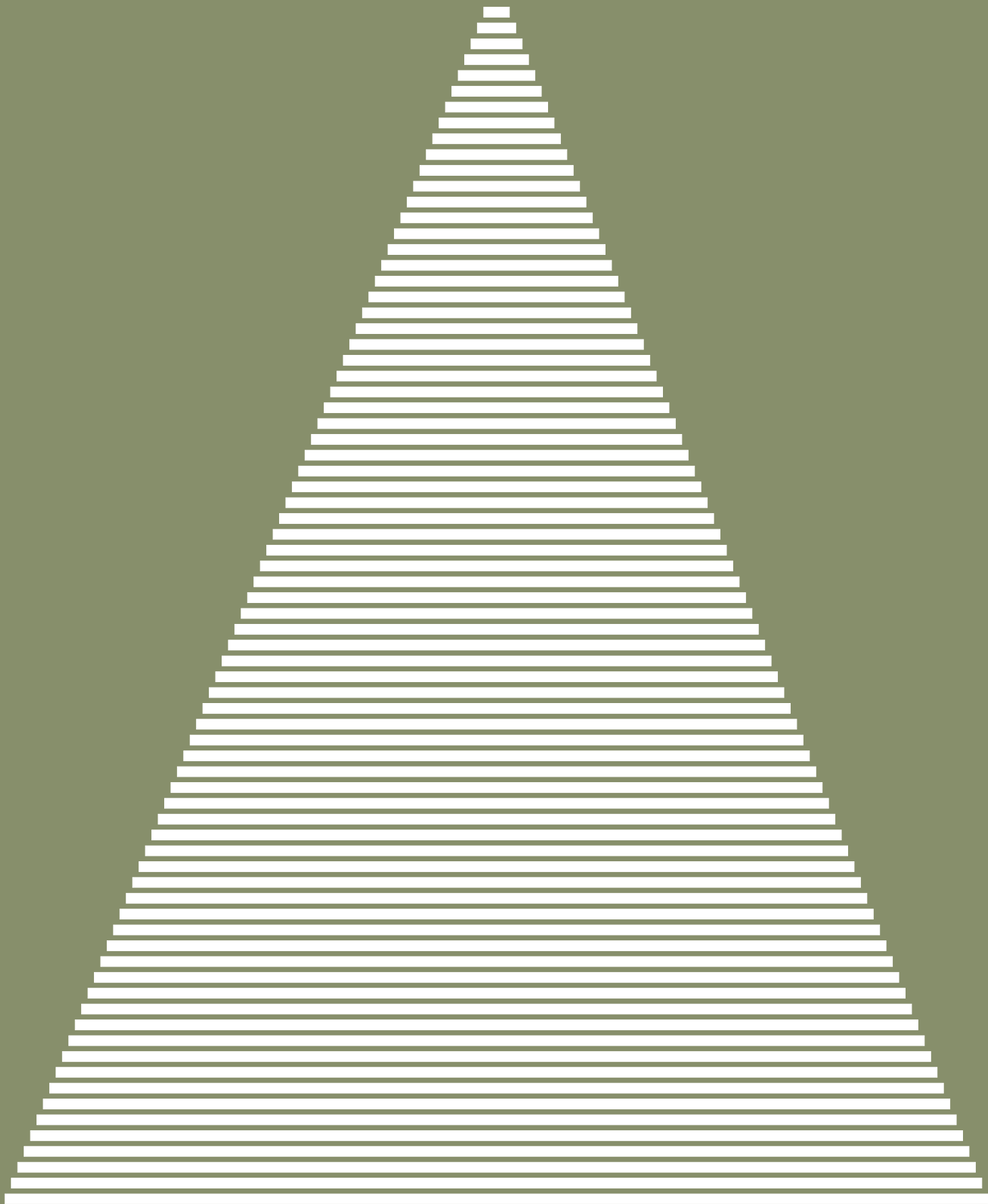
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